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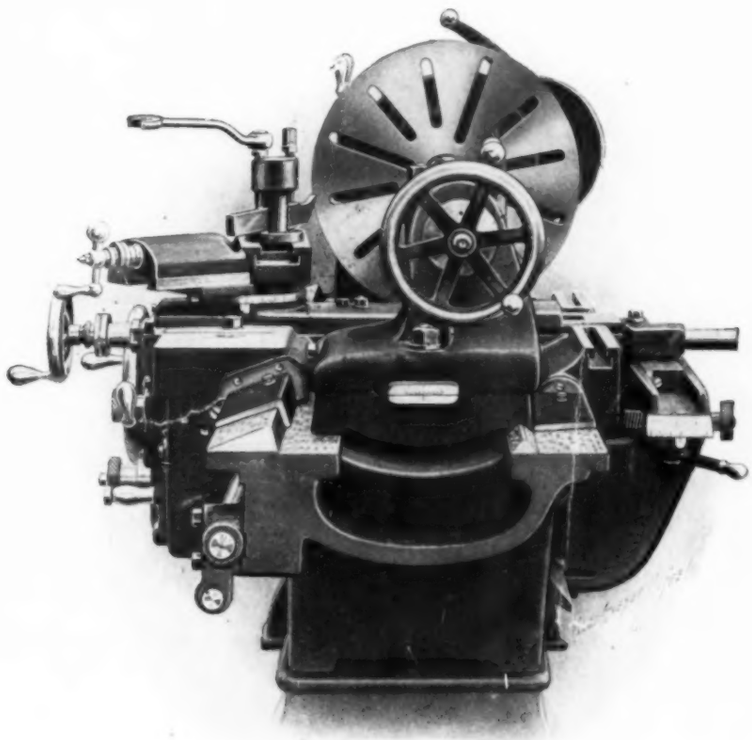
The LE BLOND Way

Insures Long Life on Accurate Work



Experience proves the usual 45-deg. angle V unsuited for modern lathes. The bearing surface on the carriage is so small that wear takes place rapidly and the lathe is soon useless for accurate work.

Our Patent Compensating V is designed with greatly increased surfaces proportioned in accordance with the pressures exerted on the carriage.

The actual bearing surface of the carriage on the ways of our 17″ Heavy Duty Lathe, is 118 square inches, or three times that usually found on a 16″ Lathe.

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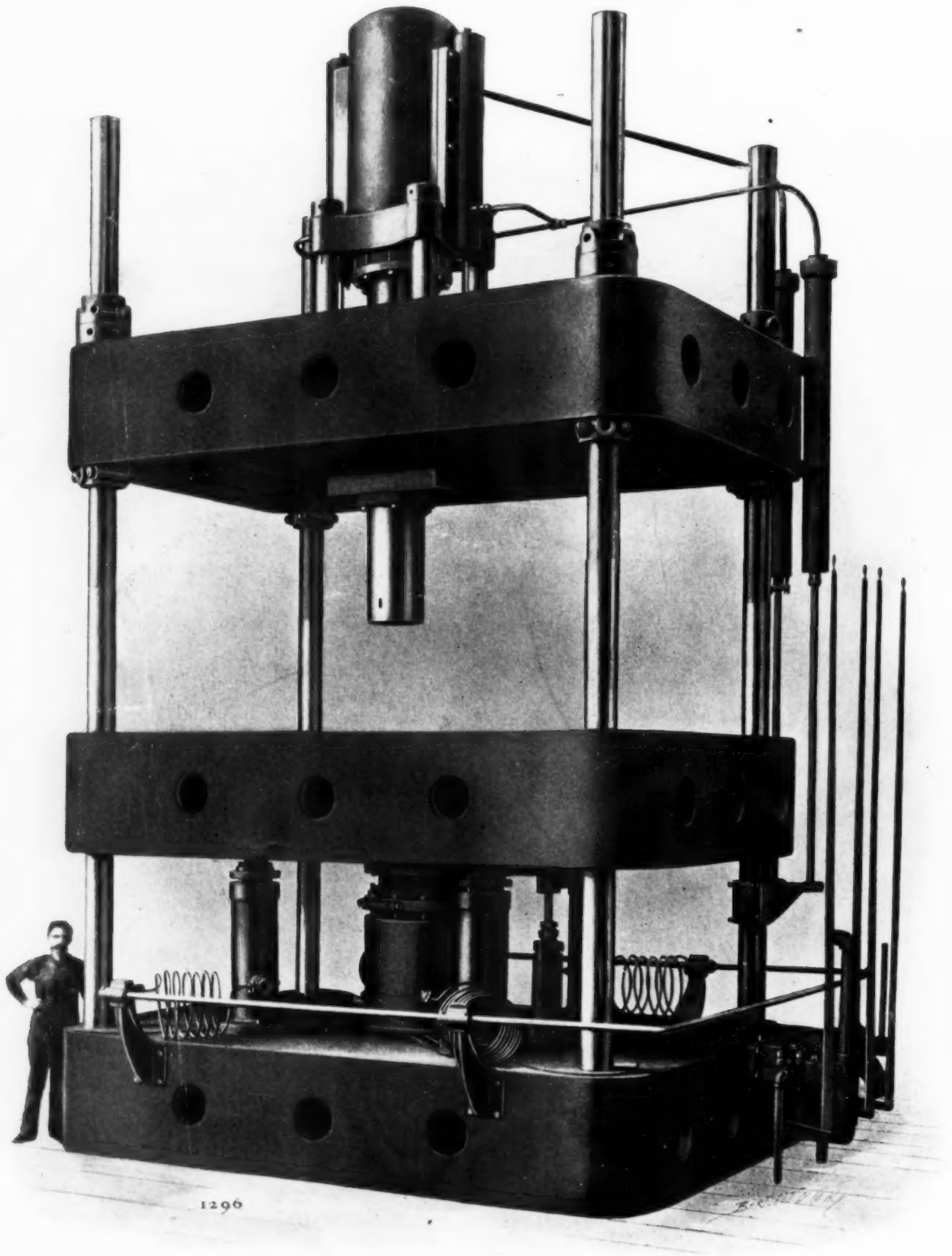


Modern Automobile Building Methods in a French Shop

Machines Used in Making the Berliet Car in Lyons, France

Special Correspondence

It is always interesting to compare machine methods on similar work in different shops and particularly when these are in different parts of the world. The careful observation of methods proves conclusively that no one shop or country has a monopoly of mechanical ideas and ingenious devices and there are a number of interesting points to be observed in the illustrations which follow from the Berliet automobile factory in Lyons, France. It is unnecessary to refer to all of these illustrations separately, as in many cases the titles give all the information necessary, and we shall only call attention to such views as show methods and machines, which are not usual, even if not extraordinary.

In Fig. 1 we have an unusual tool setup on the turret of the vertical boring mill, which, in the illustration shown, is only being used in facing off the bottom flanges of the cylinder. Large special boring and outside turning tools are shown mounted on the turret faces in a somewhat unusual manner. In order to secure a substantial support the tool casting has been seated on two faces of the turrets to insure rigidity and avoid spring.

Unusual Cylinder Boring Machine

In Fig. 2 is an unusual form of cylinder-boring machine, the general outlines assuming the form of a drop hammer. As can be seen in the details shown in Fig. 3, the cylinder castings are mounted on the sliding table *A*, of the frame and led into position under the

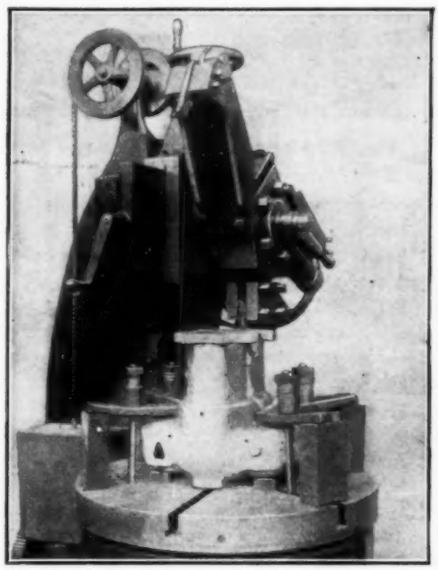


Fig. 1. Facing Cylinder Faces

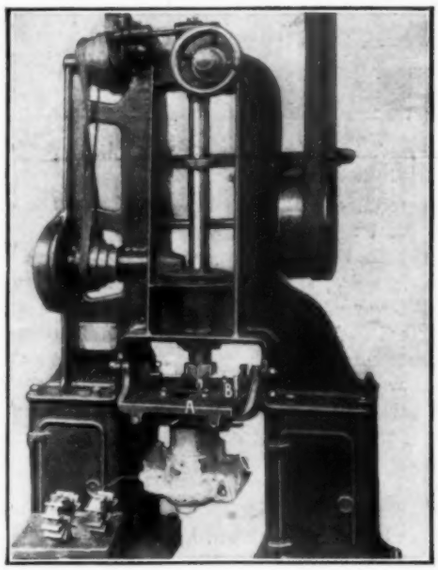


Fig. 2. Special Cylinder-boring Mill

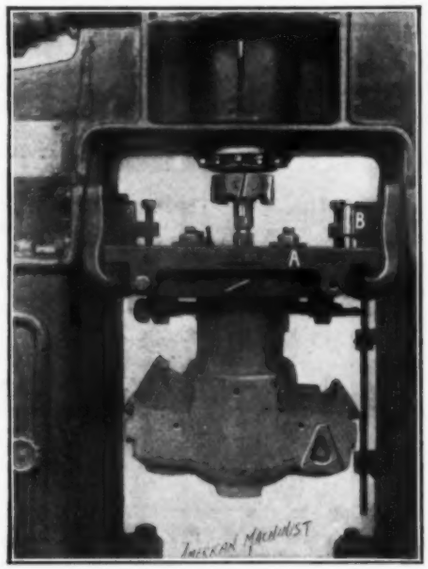


Fig. 3. How the Cylinders Are Held

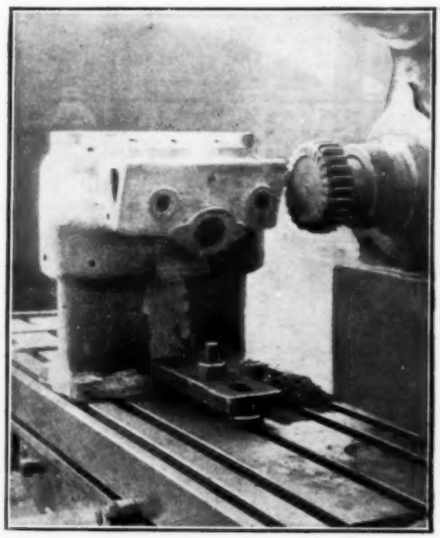


Fig. 4. Milling Pads for Ignition Mechanism

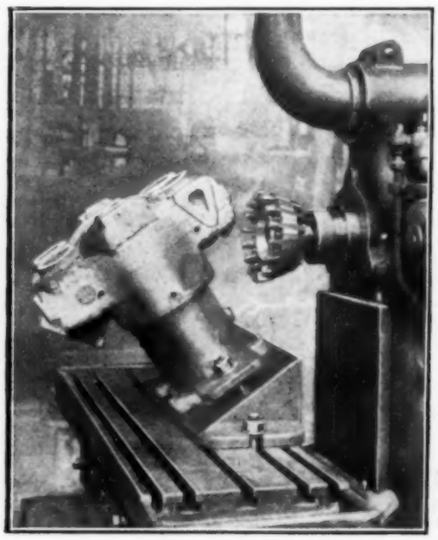


Fig. 5. Milling Inlet and Exhaust Flanges

Fig. 6. Plugging Core Holes in Water Jackets

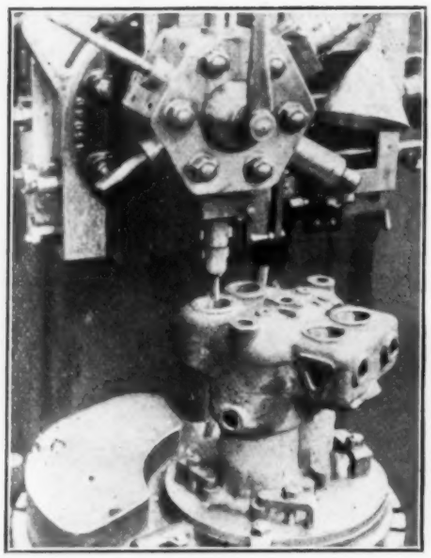


FIG. 7. BORING VALVE-CHAMBER HOLES

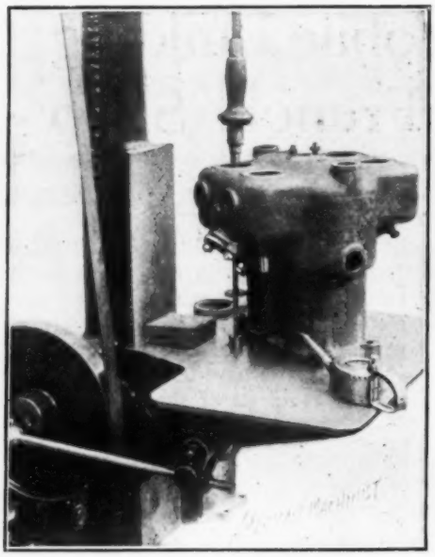


FIG. 8. GRINDING IN VALVES

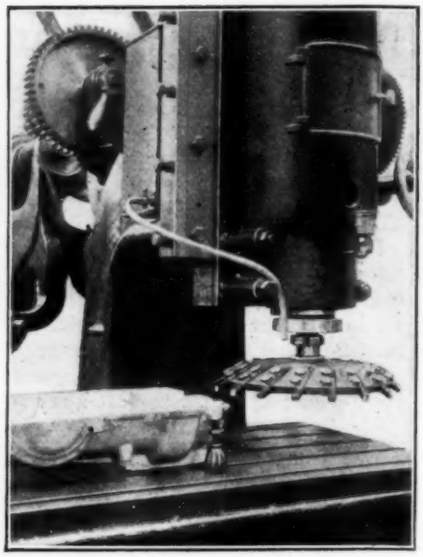


FIG. 9. MILLING TRANSMISSION CASES

fixed boring bar. The index pin *B* locates the cylinders in their proper position and while they are being bored another plate is being placed so that it is almost a continuous operation. This also shows the kind of cutter used.

Fig. 7 shows an index fixture used on a vertical boring mill for locating the valve-chamber holes and is very similar in its general plan to a device used in this country.

In Fig. 8 is an interesting device for grinding in the valves. The valve is driven through a flexible shaft from above and there is an automatic tripping device, operated by a crank below, which lifts the valve from its seat every two or three revolutions.

Fig. 9 shows the very heavy vertical milling machine, carrying a large inserted tooth cutter for facing the transmission case shown.

In Fig. 12 we see the methods used in insuring sufficient clearance in the front cover of the crank case for the inlet and exhaust cam-shaft gears. A hardened bushing in the shaft holes guides the sweep cutter, which removes any obstructing portions of the casting and insures free running gears.

SOME CHUCKING METHODS

Figs. 14 and 15 show two methods which are also used by at least one shop in this country. The first is a special chuck for holding the crank-shaft bearings in such a way that they are sure to be bored with the parting line in an exactly central position, this being done by the projecting lips on the box coming in contact with the locating jaws in the chuck. The connecting-rod device is also used in a few places although slightly different holding devices are used.

Fig. 16 shows a rather interesting profiling operation on a hand milling machine, the dies or formers being located at some distance above the milling spindles so as to use the overarm for a pilot.

Another interesting boring mill set-up is shown in Fig. 19 where the large driven sprockets are being turned on the outside and bored inside at the same setting.

In Fig. 21 is an interesting little machine for splining the slot in the valve stems. This is accomplished by a rapidly running fish-tail cutter, which has an oscillating motion depending on the length of the slot to be milled. An in-

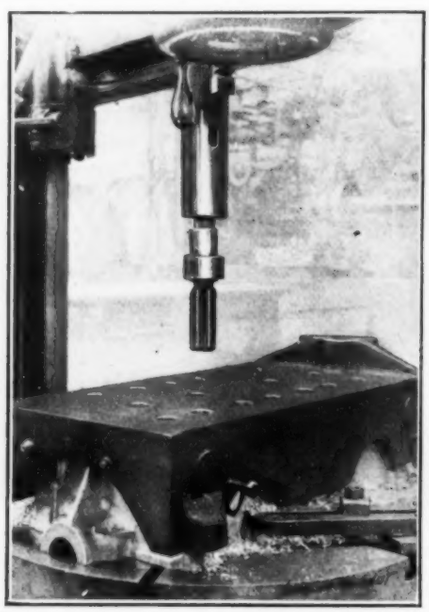


FIG. 10. FLANGE-CASE MILLING JIG

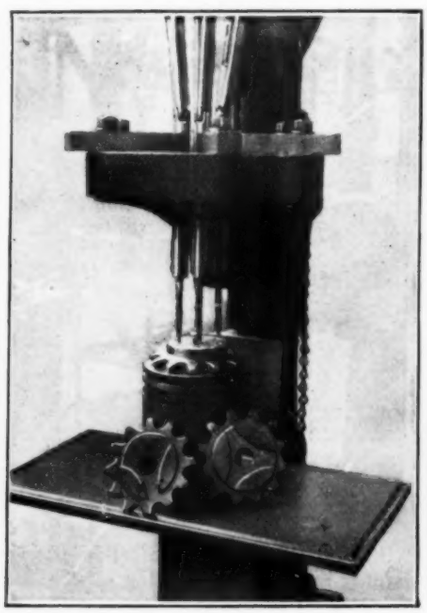


FIG. 11. DRILLING THE DRIVING SPROCKET

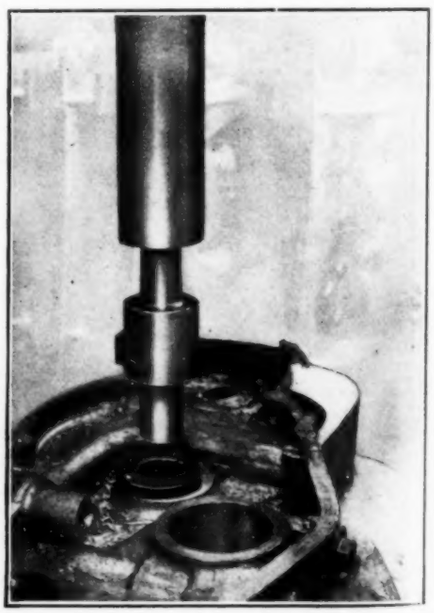


FIG. 12. BORING CRANK-CASE FRONT COVER

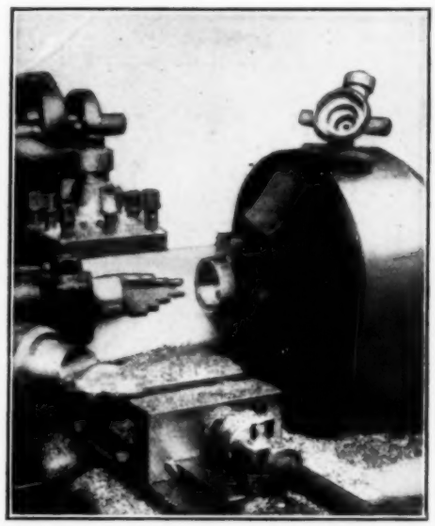


FIG. 13. BORING TIMING MECHANISM

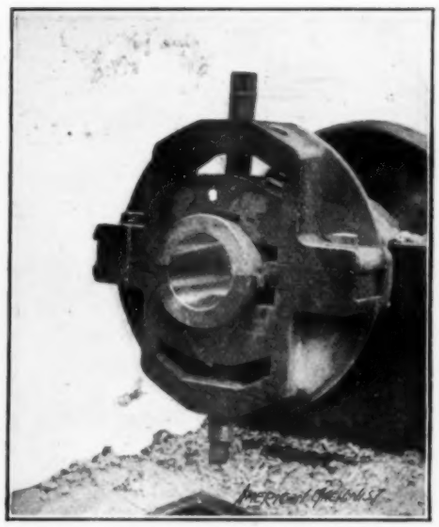


FIG. 14. BORING THE CRANK-SHAFT BEARINGS

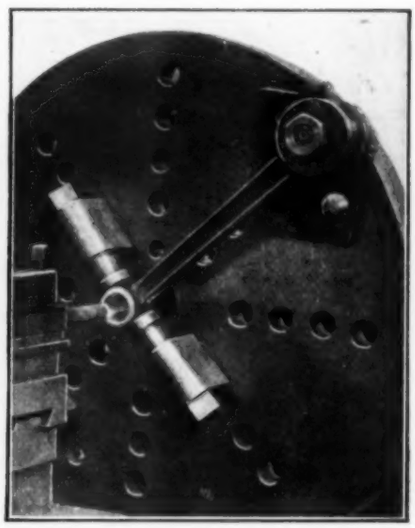


FIG. 15. BORING CONNECTING ROD

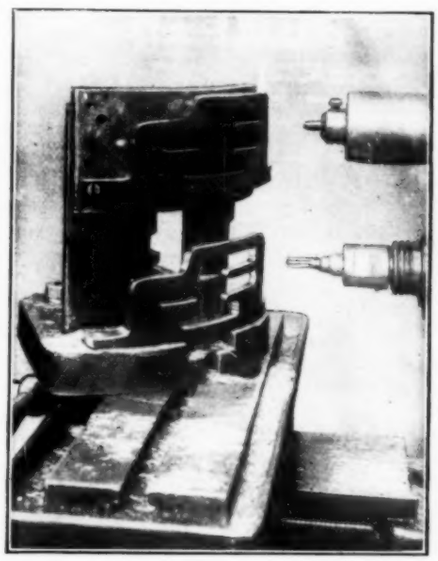


FIG. 16. PROFILING CONTROL-LEVER GUARDS

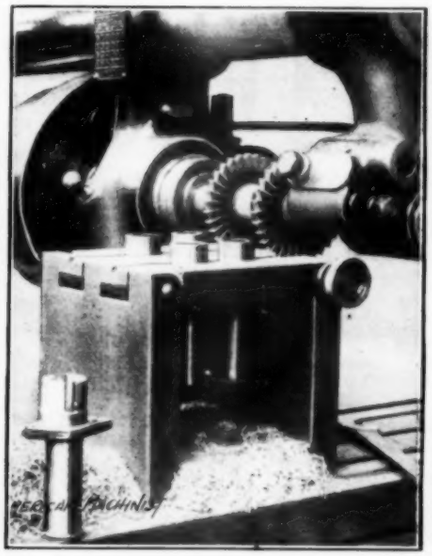


FIG. 17. MILLING VALVE GUIDES

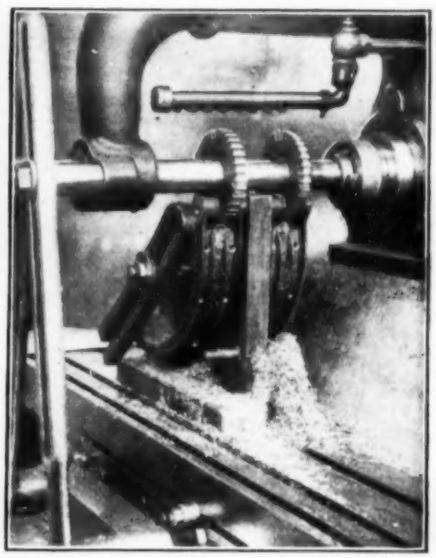


FIG. 18. MILLING BRAKE BANDS

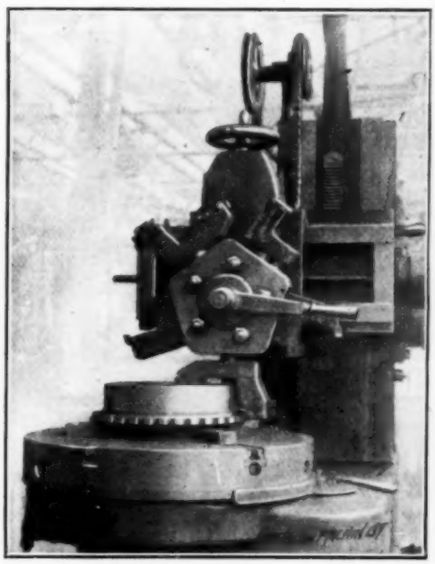


FIG. 19. TURNING DRIVEN SPROCKETS

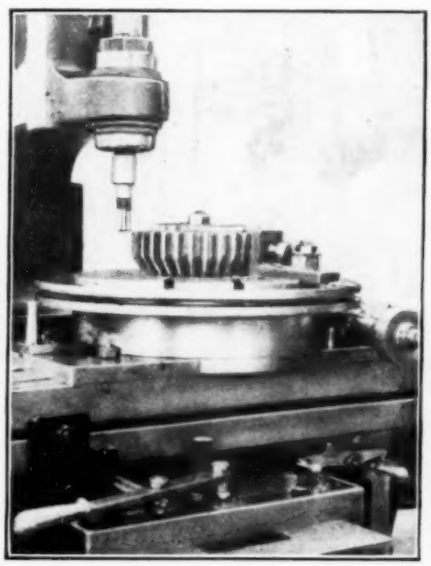


FIG. 20. MILLING TRANSMISSION GEAR CLUTCH

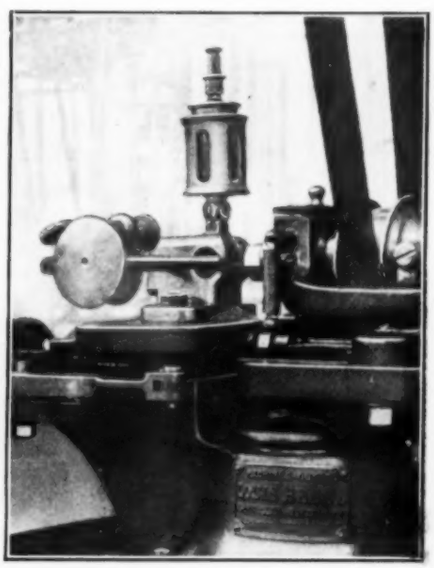


FIG. 21. MILLING KEYWAYS IN VALVE STEM

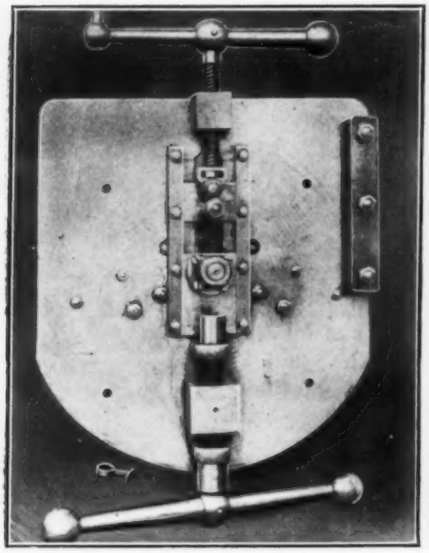


FIG. 22. FORMING FIXTURE FOR SMALL BRACKETS

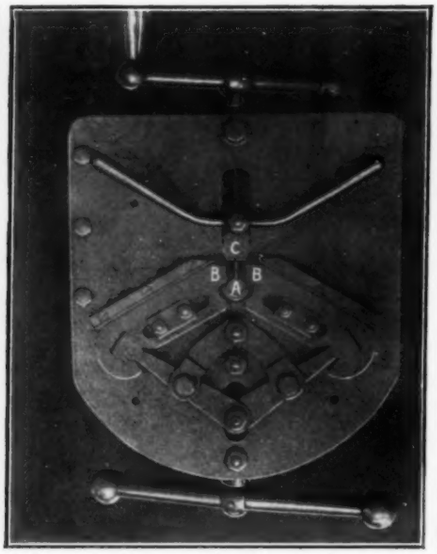


FIG. 23. THE WAY IT DOES THE WORK

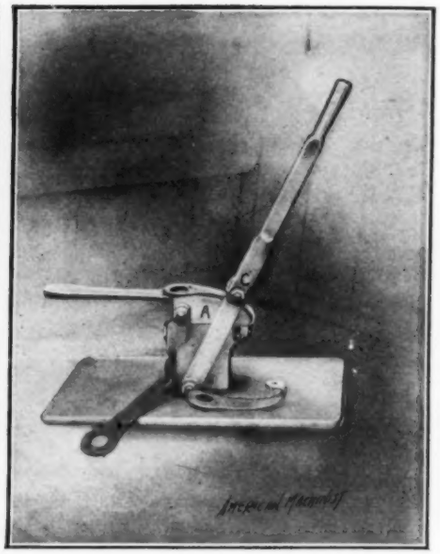


FIG. 24. FIXTURE FOR FORMING SPRING CLIPS

teresting feature is the sight-feed lubricator mounted on the jaw which holds the valve stem for lubricating the cutter.

TWO BENDING FIXTURES

Figs. 22 and 23 show the front and back sides of an interesting forming fixture for bending up small ratchets used to support a hand air-pressure pump on the dashboard. It can be readily seen that if the central pin *A* is raised above the jaws *B B* and a straight piece laid across these jaws, a downward movement of the pin *A* will force the piece between the jaws into a U, after which the jaws *B B* can be forced in, forming the circle and bringing the ends together. Then the block *C* is forced down, turning the end at right angles against the jaws *B B* and completing the operation.

Another interesting fixture is shown in Fig. 24, together with the springs clip, both before and after bending. After the lever *C* is moved to its lowest position the hole in the end of the clip is placed over a pin in the jaw *D* and the clamp *A* swung over to hold it in place. An upward movement of the lever bends the clip over the forming block *A* to the desired shape by means of a roller between the two forks of the lever.

Fig. 25 shows the method of turning a six-throw crank shaft, using indexed plates on the end of the shaft to insure the proper location of centers and also shows a very simple method of using counter weights.

In Fig. 26 is a special machine for milling integral cam shafts, the shaft being held in the hollow spindle and indexed as to proper position, both as to angularity and length.

FIG. 25. TURNING A SIX-THROW CRANK SHAFT

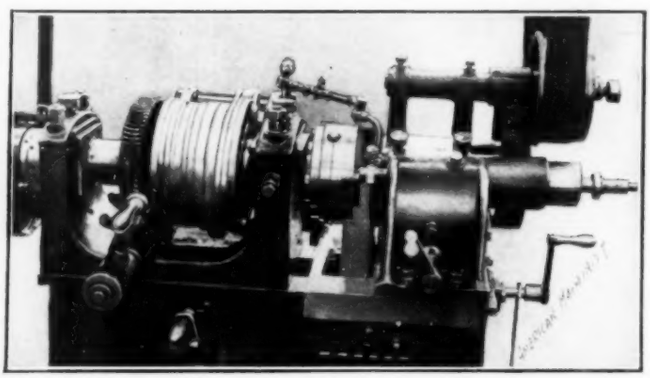


FIG. 26. CAM-SHAFT MILLING MACHINE

FIG. 27. DRILLING JIGS FOR FRAME HOLES

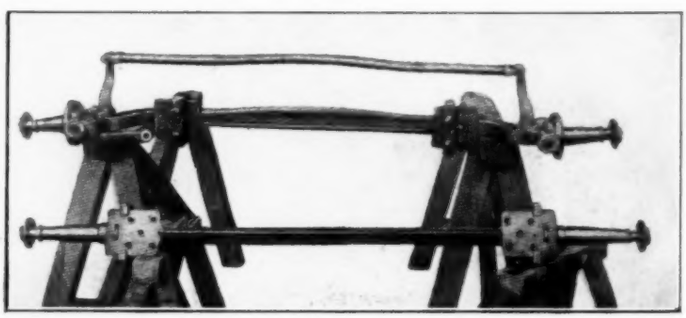


FIG. 28. DRILLING JIGS FOR AXLES

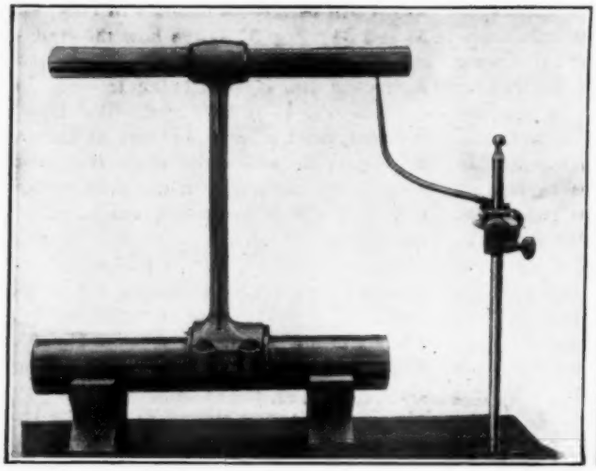


FIG. 29. TESTING CONNECTING-ROD ALINEMENT

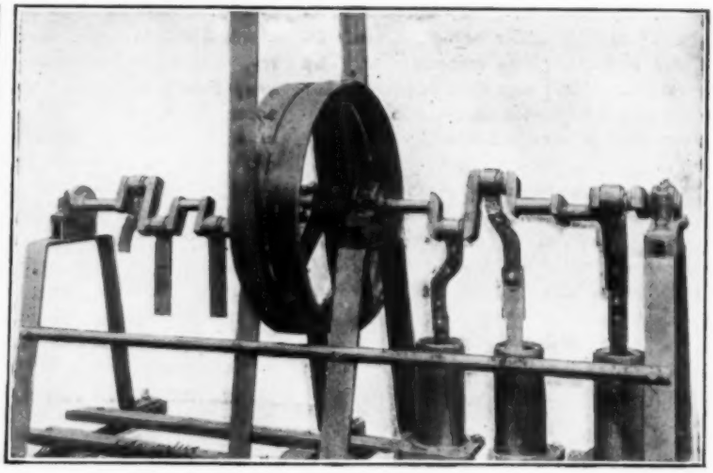


FIG. 30. LAPPING IN PISTON RINGS

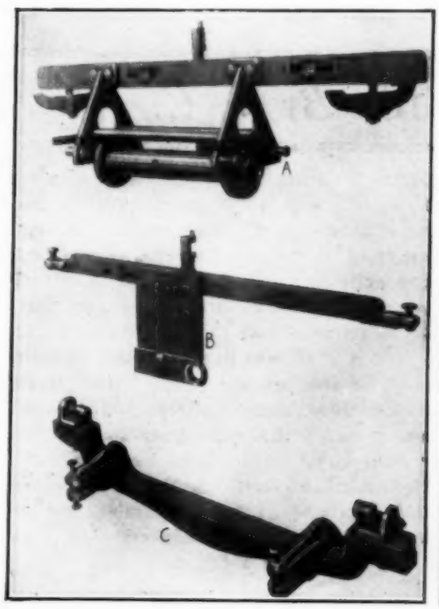


FIG. 31. TESTING FIXTURES FOR ASSEMBLING

FIG. 32. ALINING TRANSMISSION

FIG. 33. DRILL JIGS FOR BACK OF FRAME

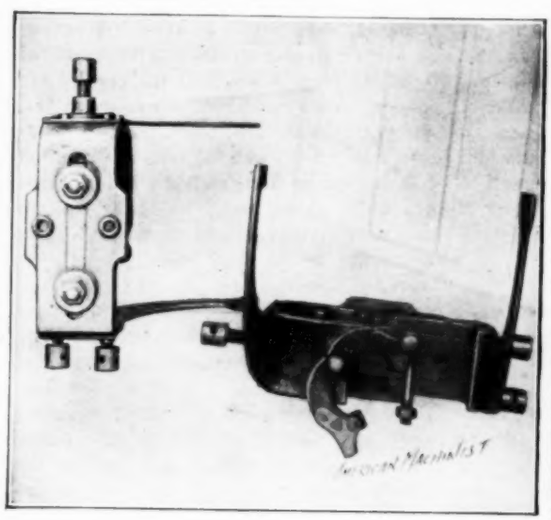


FIG. 34. ALINING FIXTURE FOR CHASSIS

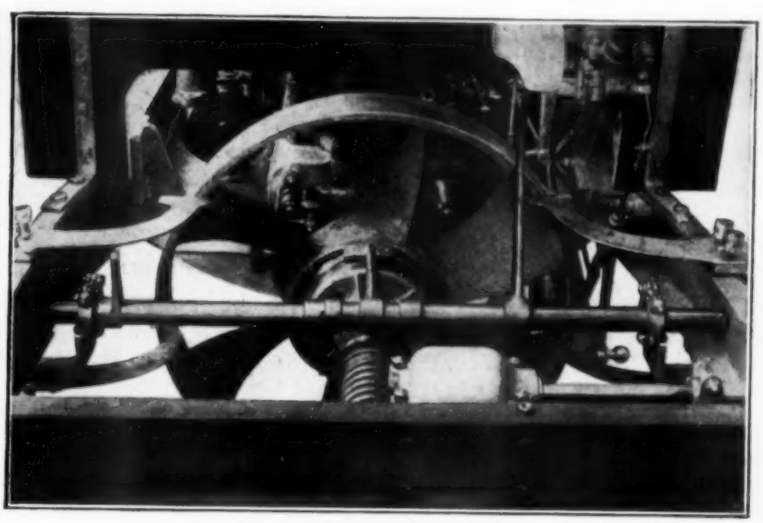


FIG. 35. THE WAY IT IS USED

Some of the drilling jigs are shown in Figs. 27 and 28, these being for the side frames and the axles respectively. The jigs for the side frames are separable for convenience in handling, as can be seen by the thumb nuts and dowel pins where they are connected together.

In Fig. 29 is shown the method of testing the alinement of the wrist- and crank-pin bearings. A standard rod is put through the wrist pin *N* while the crank-pin bearings are placed on a ground shaft, suported on V blocks. When the rod is turned end for end it is very easy for the gage shown to detect very slight errors.

Lapping Piston Rings

The method of lapping piston rings is shown in Fig. 30. One-half of the lapping machine is at work and the other idle, while the false cylinders are being fitted with a new lot of piston rings to be lapped. This is a common practice in Europe and in some shops in this country. Some use emery and oil in varying proportions, kerosene being preferred by some, to a heavier oil. In a few instances sapolio is used as an abrasive, either with water or with kerosene. In some of the plants the first lapping is with emery and oil, then the proportion of emery is gradually reduced until the last lapping is practically with kerosene alone, which must come through the cylinders practically without discoloration, before the rings are finally passed for assembling. In some instances they are lapped into their own cylinders in this same way.

Method of Alining the Chassis

Some of the methods for alining the engine and the transmission on the chassis are extremely interesting. Fig. 31 shows three of the instruments used, which will be seen in position in Figs. 32, 33 and 34. Fig. 32 shows how the transmission case is lined up by use of the fixtures *A* and *B*, both being fastened to the side frames as indicated. The alinement of the transmission case is shown in 32 and 33 where the shaft *D* passes over *C* and is located in the drilling fixture *B* while *A* locates it crosswise of the shafting.

Fig. 34 shows a pair of indicating fixtures which are used in testing the alinement of the side frames with the flywheels of the engine as seen in Fig. 35. These indicators are clamped around the clutch shaft as shown, and indicate very clearly any lack of alinement between the engine and the side frames.

This method of assembling indicates the extreme care taken to insure everything being in line before it leaves the factory and is typical of all shop operations.

Pittsburg Finish and Deep Scratches *By C. C. Howe*

Pittsburg finish—high polish and deep scratches—is of national repute. It originated during the early days of the city's experience in the machine industry, when the work done was of the plainest, roughest character and I guess the term was a fit one at that time. While the machine shops east of the Alleghanies were taking pains to keep some department at a constant temperature to secure accurate measurement the Pittsburg shops were using a yard stick and allowing "some" for a fit at that. But their machines ran, and work was handled! In view of the fact that the appliances then used would have floored anyone trained under modern conditions, the results attained are less a subject for criticism than wonder.

In a steel mill a breakdown was a serious affair, and a delay of any length an utter impossibility. The parts required, therefore, must be made at once and with the means at hand, whatever they were.

This class of work developed a set of men who, while they were never especially accurate, could always make out somehow, the parts would go together if they had to use a sledge, and would operate it if you put power enough behind them—and what did that matter, coal was cheap.

An Experience With a Gear Cutter

When I was younger I innocently secured a job for a machinist of this class (there are a few of them left) in a shop where I was employed. My conception of a machinist did not cover this type and the results were unexpected. One of his first jobs was to repair a Brown & Sharpe No. 13 gear cutter that "ran a little tight somewhere," so the operator said. My man first tried to take off the carriage. All the carriages that he had ever seen slipped off over the end of the ways; it happens, however, that these carriages lift straight up, one of the gibs first being loosened. There is a case containing the feed gear in front that prevented it being taken off his way, so he proceeded to "carry his message to Garcia" by chipping off the gear case. Luckily someone noticed what he was up to in time and the case was saved. He finally got the machine apart and together again—he got all the "pieces" in somewhere and said she was ready. The machine was a little tight when he took charge of it, but when he was through it could not be moved with a rail.

On the other hand, put a man capable of repairing this machine on the work that my man had been used to and the results would have been just as tragic. Give such a man a micrometer, and he would jam the thread the first time that he tried to use it; but he could make a press fit just the same. Give him a small fine piece of work, and if he did not lose it among his tools or through a crack in the floor, he would distort it beyond repair—that was not his line.

The Old Pittsburg Shops

The old Pittsburg shops were dark gloomy places with dirty floors and dirty windows. Perhaps you could find an office and perhaps you could not, sometimes they had none—except what the boss carried in his hat. It was easy enough to get in, and perhaps wander around for an hour or so without anybody bothering you, and again it might happen, if you had no business to transact, that your exit would be sudden and hasty, accompanied by a fine flow of Scotch-Irish profanity. It was not at all unusual to enter a shop where, according to the sign out front, special machinery was designed and built, and find the place half full of structural columns, or perhaps a carload of "whatnots" that had been taken in to help out—"all was fish that came to their net." Some of the shops had three closed sides, and in winter you dressed accordingly; the heat generated in removing stock those days was not sufficient to offset such conditions. Or again the open end of the shop might be up against a bessemer converter—it was either a feast or a famine.

The Present Pittsburg Shops

There are only a few such shops left; the greater part are modernized; many have removed to the surrounding country. On the whole, conditions have entirely changed, they have combined accuracy with their resourcefulness and knack of handling large work, and the results are second to none. The largest machines, such as rolls for mill work, the base casting for which weighs one-half million pounds, are as accurately built as a high-grade "machine tool," the bearings are as carefully lined and fitted—the only difference is in the magnitude of the work. The bearing-cap bolts, for instance, are drawn down by a 100-ton crane on the end of a 12-foot wrench. The smallest work (barring watches and such) is produced in a large way—in fact there is nothing small about anything they do. And "Pittsburg finish" is now better suited to other portions of the country; the original specifications are not being followed there. The scratches have all disappeared but they still retain the high polish as of yore.

Good Work in Manufacturing Speed Lathes

The building of a speed lathe on a manufacturing basis, whether for trade schools or other places, requires good work and constant care if the product is to be satisfactory to its users. The lathes here described are the outcome of the speed lathes built by Hiram Norton in Bernardston in years gone by, but have been redesigned and improved so that their originator would hardly know them.

The beds are first planed on the bottom and then they go to the special boring and milling machine shown in Figs. 1 and 2, where three beds are operated on at one setting. It will be seen that these are held on a special base or fixture, so that they can be easily located to bring them into their proper position for the gangs of milling cutters. These are on a long arbor which is carefully supported between each gang of cutters. The ways are then scraped and the heads are ready to be bored for the spindle boxes as shown in Fig. 3.

Boring the Headstock

Fig. 3 shows the method used in boring out the headstock on an engine lathe. The headstock is cast solid with the bed and the jig shown is lowered on to the lathe bed to be bored, which rests on cross pieces on the bed of the lathe in which the work is being done. This jig is clamped to the ways of the lathe bed to be bored and is provided with hardened steel bushings which locate at the guide the boring bars and the reamers used. Two reamers are used, one for roughing and the other for finishing the holes for the spindle boxes. This is a very convenient way of doing these as the bed to be bored and the fixtures are easily handled by the tackled block over the lathe on which the work is done.

The tail blocks are bored out in the same way and with the same fixtures, which insures proper alinement with the headstock. After they are put together, they are hand reamed as shown in Fig. 4, to take out any slight inaccuracy which might come from being strained in the machine. These are reamed from both ends, the reamers being guided by hardened steel bushings at each end. They are then scraped to secure an accurate fit, and after the spindles have been mounted in their bearings, the taper is

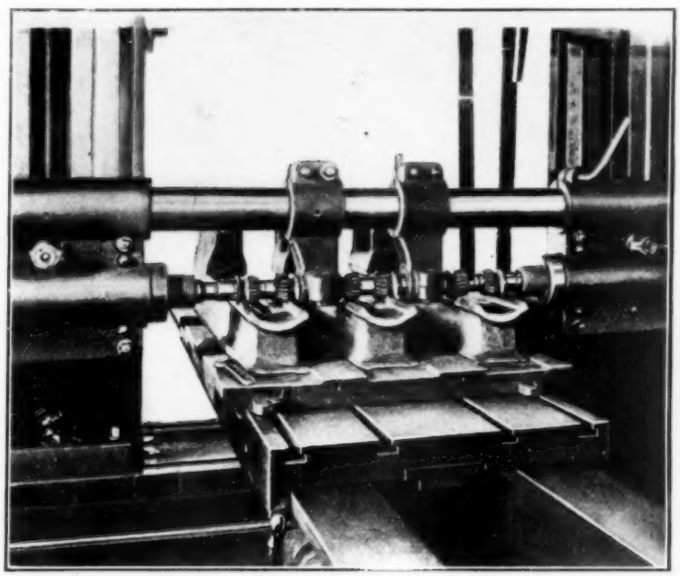


Fig. 1. Milling Three Lathe Beds on a Special Machine

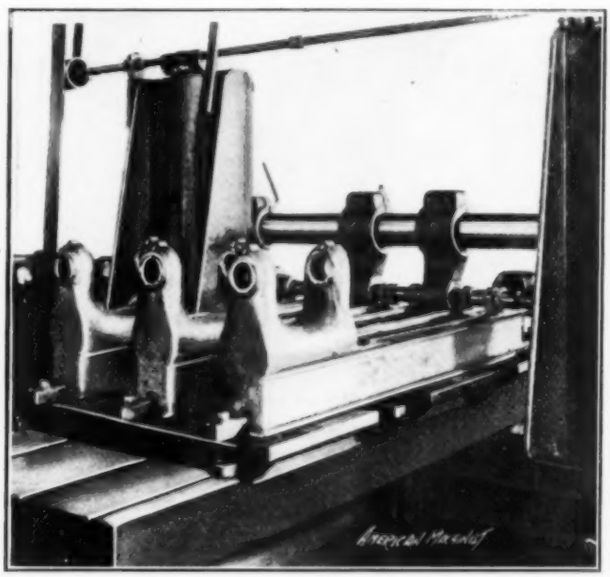


Fig. 2

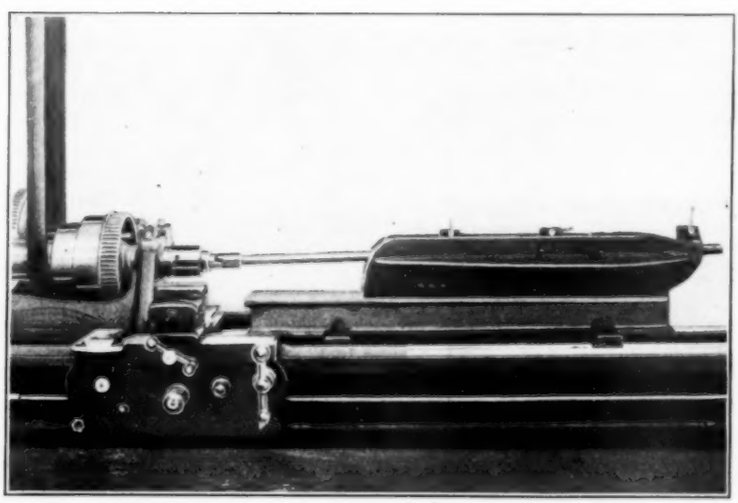


Fig. 3. Boring Heads for Spindles

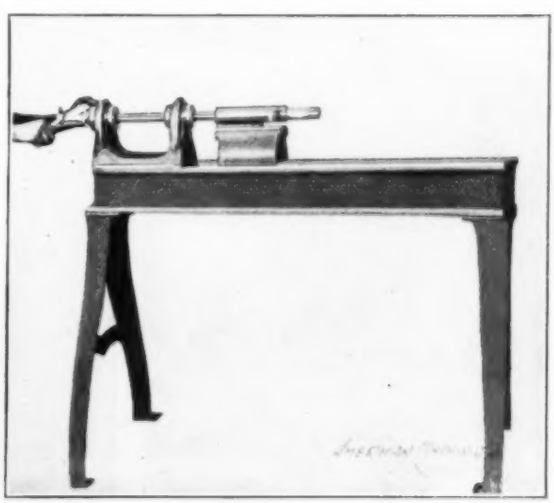


Fig. 4. Hand-reaming Head and Tailstock Boxes

FIG. 5. BORING THE TAPER IN SPINDLE

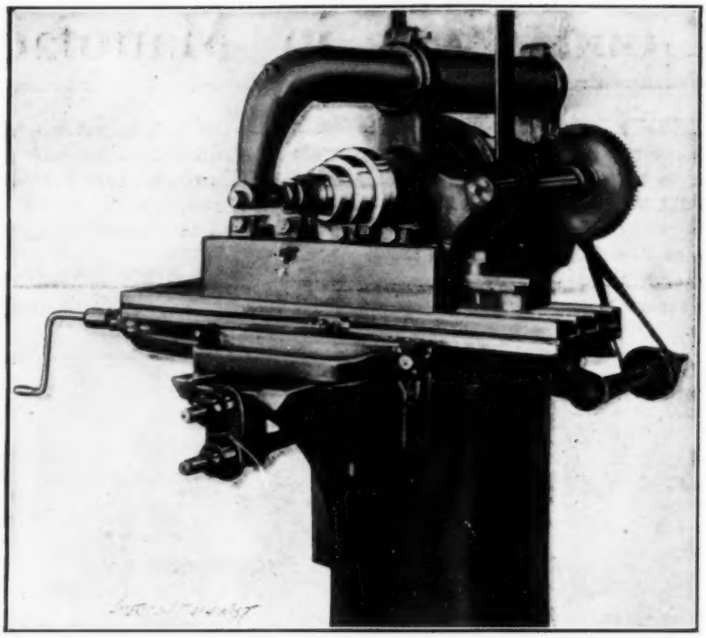


FIG. 6. TURNING THE CONE PULLEYS

bored out, as shown in Fig. 5, by a special slide rest, which can be swiveled to the desired taper. This boring is done with a single-point tool, which is followed by a hand reamer that removes very little stock.

TURNING CONE PULLEYS

The method of turning cone pulleys is very different from that usually employed, as can be seen by referring to Fig. 6. The cone pulley is first bored and mounted on an arbor in the milling machine shown, while the turning or forming tools are fitted to the substantial slide, which is mounted on the milling-machine table. These tools are so spaced that only one cone is being operated on at one time, and the regular milling-machine table feed moves the tools under the cone to be turned, so that a cone is completed at a single passage of the forming tool. This leaves them ready to be polished with a buffing wheel so that, after being balanced they are all ready to be assembled.

The bronze bearings are tapered on the outside and adjusted by draw-in nuts at each end. The oil channel for returning the oil to the well, in which the oiling ring runs, is deeper at the center and is cut in a very ingenious way. The fixture shown in Fig. 7 is attached to the shaper table, which holds the bushing at the required angle to cut it enough deeper at the center as the tool goes in from one end. This tool is held in the projecting bar *A*, which is braced to the tool-holder itself by the hinged brace *B*, the bar *C* carrying a hardened steel roller in the end, as can be seen. When the cutter has reached the center, or deepest part of the oil channel, the roller strikes the incline *C*, which lifts the cutter sufficiently to give the desired incline in the opposite direction. This enables these oil ways to be cut very quickly and easily and the fixture is not an expensive one to make.

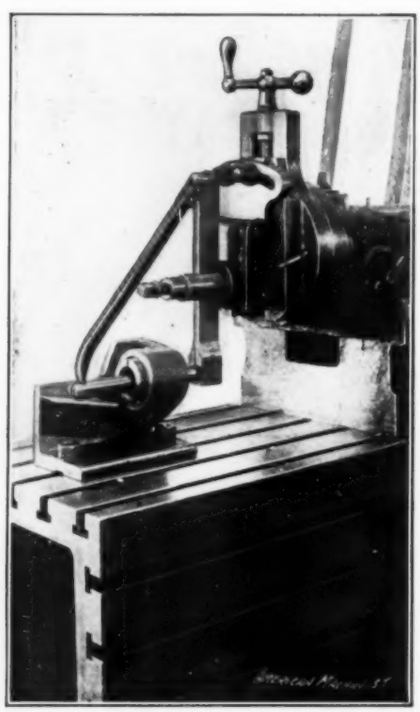


FIG. 7. PLANING A CONCAVE OIL GROOVE

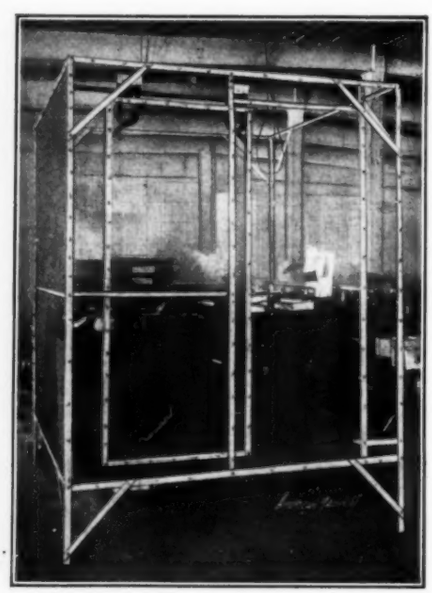


FIG. 8. THE SUPERINTENDENT'S PORTABLE OFFICE

A PORTABLE OFFICE

Another interesting feature of this shop is the superintendent's office, which is shown in Fig. 8. This consists of a portable wire cage (for want of a better name) which contains the superintendent's desk, cabinet, chair and other conveniences. It is raised so that he has a good view all over the shop and in every direction. It does not obstruct either light or air in any way, everything can be locked up instantly if desired, and the whole thing can be moved to any part of the shop as circumstances may demand.

According to the *Brass World* hydrofluoric acid is the best agent to use for removing sand from castings, particularly those of iron and steel, as it attacks the sand and dissolves it, while other acids attack the metal and only loosen the sand so that it falls off.

Methods of Handling Automatic Turret Work

The Advantages of Using Special Work Holding Fixtures

By F. A. Stanley

An important feature of the automatic turret machines built by George G. Prentice & Co., Incorporated, New Haven, Conn., is the facility with which the chucks and face plates of these machines may be equipped with special jaws and holding fixtures of various kinds for handling castings and forgings of almost any shape and of any dimensions within the capacity of the machine. This machine, together with methods of building and testing it, has been illustrated recently in these columns, and it is the object of the present article to show ways and means of handling various pieces upon chuck or face plates; a number of such parts being shown in Fig. 1. Most of these pieces will be recognized at once as automobile parts, which have to be drilled, faced, bored or tapped.

As stated in previous articles, this type of machine is made either with single or double heads, and the chucks and face plates for the two styles of machines are illustrated in Fig. 2. With either machine the work-holding chuck has one more section than there are spindle positions, and this allows the operator to remove finished work and put a rough piece in place before the chuck indexes to bring the piece opposite the first spindle. The spindles and their tools are so arranged as to work simultaneously on three pieces of work in the four-section chuck, or on four pieces of work in the five-section chuck, and so on, and the tools are so adjusted that when the chuck with its several pieces of work attached is fed toward the tools the latter cut to the correct depth, and as the chuck is indexed step by step to the different tool positions, the tools perform a series of operations in unison upon as many different pieces.

Work on a Clutch Fork

Referring to the halftone, Fig. 1, a drop-forged clutch fork is shown at *A*, as it appears before and after drilling. There are three distinct operations on this piece in the automatic turret machine, the first consisting in drilling and reaming the body or hub; the second, drilling and reaming the fork holes; the third, drilling, facing and tapping for the binder screw. The first operation is performed with the work held as shown in Fig. 3, in fixtures mounted on a four-section chuck in a double-head machine. In the drawing only one holding fixture is illustrated mounted on one of the chuck arms. Actually there are four of these fixtures in use at the same time. The sketch shows only enough of the chuck outline to indicate its general form.

The work outline is indicated by dot-and-dash lines, and the means of securing it in the holding fixtures is brought out clearly in the engraving. The hub or body of the piece has been milled to length before placing in the fixture, and as shown in Fig. 3, this body is forced into a form of V-block *a*, between two drill bushings by means of a swinging plate *b* clamped by a nut on a swing bolt. The tools are shown in the sketch, Fig. 4.

The first pair of spindles, as indicated in Fig. 4, present a pair of spotting drills to the work, which when indexed to the second position is drilled nearly to the center by a second pair of twist drills. In the third position a drill is run in from one side to complete the roughed hole, after which the hole is reamed to ⅞ inch diameter from the other end as indicated. The drills following the spotting drills do not fill the guide bushings, but are guided by the centers formed by the spotting tools, which as shown in the sketch, are guided by the bushings. The reamer, of course, fills the guide bushings and is fed through rapidly upon the withdrawal of the drill in the opposite spindle.

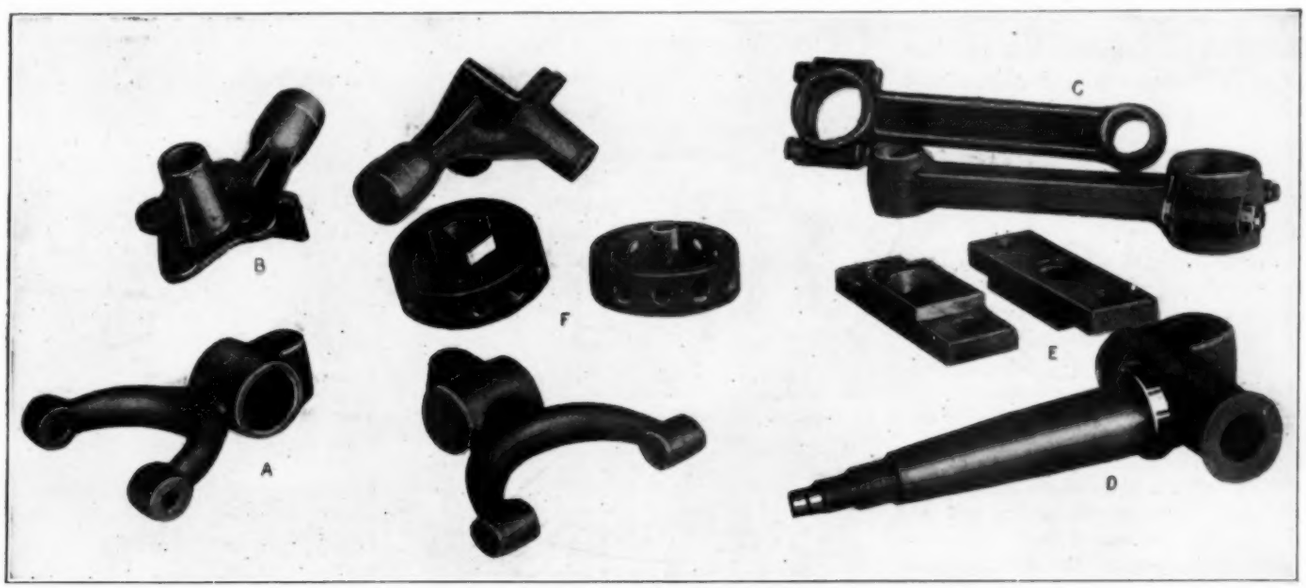


Fig. 1. Some Parts Handled on the Prentice Automatic Turret Machine

Drilling and Reaming Clutch Fork Ends

Drilling and reaming operations in the fork ends are illustrated by Figs. 5 and 6. The work is slipped over a locating plug *c* and the two fork ends clamped securely in front of the guide bushings by a swinging strap *d*. Fig. 6 shows the sequence of operations; first, the spot drilling; second, the drilling through the lugs; third, the reaming. The chuck used is a four-section one in a double-head ma-

chine; and as in the previous case, the through drills are guided by the centers formed by the spotting drills and clear the bushings so that when the reamers are passed through they are properly guided in the bushings and there is sufficient stock left in the work to permit smooth reaming of the holes.

The third operation on the clutch fork will be understood from Figs. 7 and 8. A single-head machine with six-section chuck and five spindles is used in this case. The work is located by a removable plug *e* through the main hole and a movable chuck jaw *f* which is pressed against the piece when the chuck screw is operated. The spot drill carries a facing tool which fills the bushing and surfaces the boss around the hole. The second drill is the body size of the screw and is fed a little over half-way through the work. The third, or tap drill, completes the hole ready for tapping, which operation is accomplished with the fourth and fifth spindles. The fourth spindle carries a roughing tap and the fifth a finishing tap.

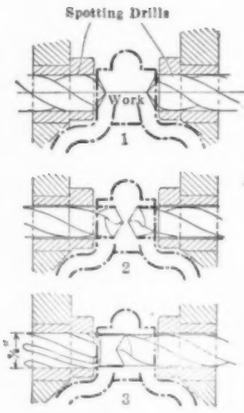


FIG. 4

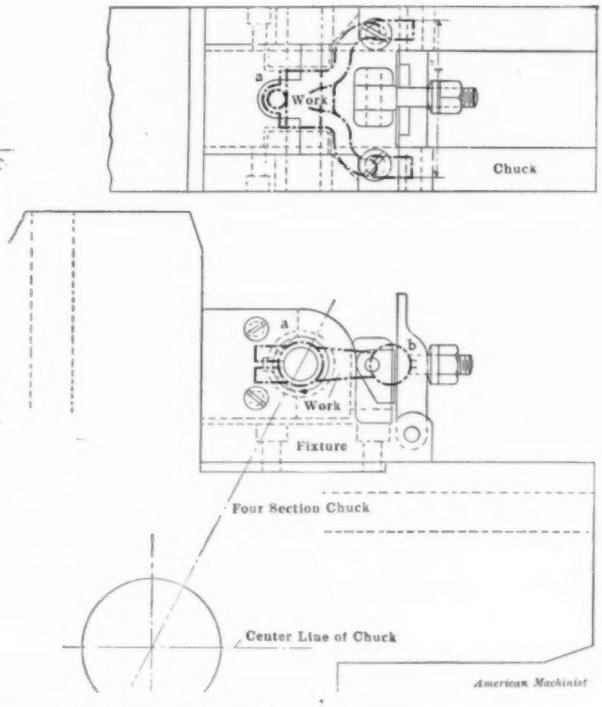


FIG. 3. FIRST OPERATION ON CLUTCH FORKS

OPERATIONS OF A RADIUS ROD BRACKET

This cast bracket is seen at *B*, Fig. 1.

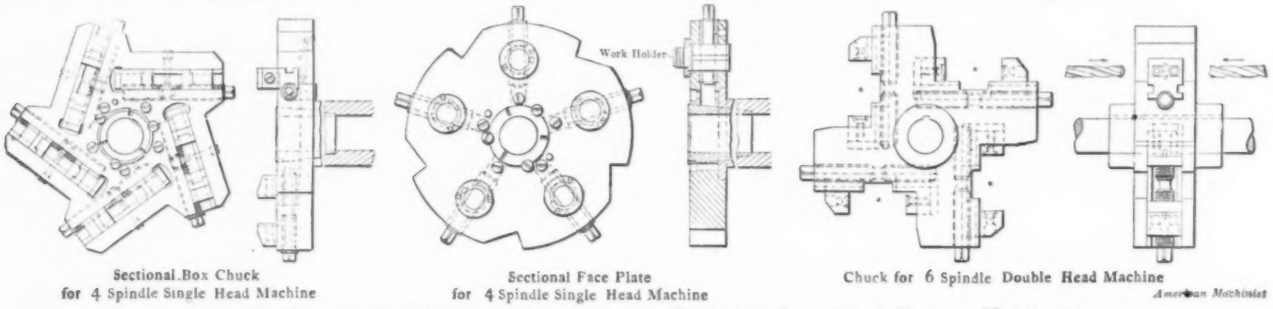
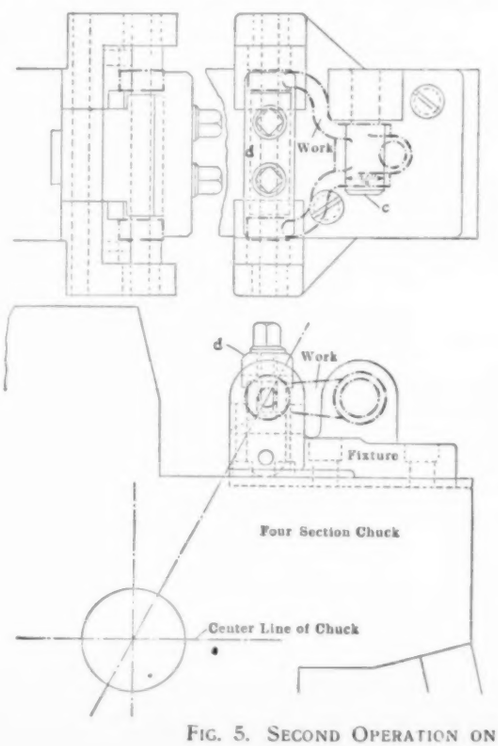

Work Holder
Sectional Box Chuck
for 4 Spindle Single Head Machine
Sectional Face Plate
for 4 Spindle Single Head Machine
Chuck for 6 Spindle Double Head Machine
American Machinist

FIG. 2. TURRET CHUCKS AND FACEPLATE FOR PRENTICE AUTOMATIC TURRET MACHINES

It is required to drill and ream a ¾-inch hole through the body of the bracket, and drill and tap the mouth of the hole and form a spherical seat 1 inch in diameter in the opposite end. The first operation is performed with the tools in Figs. 9 and 10. The work is held in fixtures on a five-section chuck, the piece being drawn back to its seat in the fixture by a clamp *g* and a wedge-shaped spring plunger *h*. The clamp *g* is drawn backward against the work by an eccentric plug *i* having a squared end for a wrench. The two springs plugs at the back of the clamp force the latter forward to release the work when the eccentric plug is turned to the proper position.

The hole is cored in the casting, and the first tool, as indicated in Fig. 10, simply forces off the end and chamfers the corner sufficiently for a three-lip drill which follows. This drill is put half way through and followed by a similar drill, which roughs the hole the entire length, after which a four-flute spiral reamer is passed through. As each drill feeds only half way through the work no time is lost in attempting to have one tool cover a distance twice as great as that of the



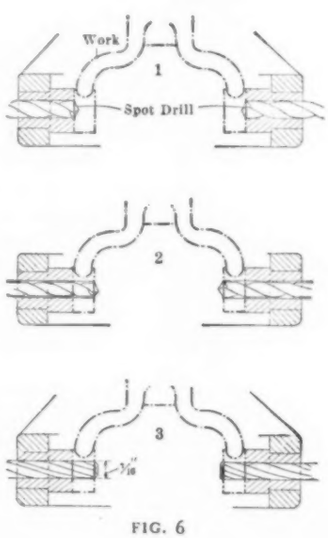


FIG. 6

FIG. 5. SECOND OPERATION ON CLUTCH FORK

preceding or following tool. In the case of the reamer a feeding lever at the back is employed, which when operated by the cam beneath, advances the reamer twice as rapidly as the other tools are operated, so that no time is lost here.

Other Bracket Tools

The next operation on the radius rod is illustrated by Figs. 11 and 12. Here the work is shown secured between two jaws which are clamped at their ends by a ring and arranged to slide into the body of the fixture, which in turn is secured to the face of the chuck. Here again a five-section chuck is employed, the tools being arranged in the four spindles as illustrated in Fig. 12. First the box tool is run onto the end of the projecting nose of the piece and a roughing drill contained in the holder in this tool is run into the cored casting. The second drill enlarges the end of the hole for tapping and roughs the spherical seat at the bottom. The third drill is a half- or D-drill, which as shown finished the bottom of the hole to a truly hemispherical surface. The fourth spindle carries the tap, completing the series of operations on this piece. The arrangement of the cutters and back rests in the box tool is indicated in the engraving. Further reference to this type of tool will be made at another point in this article.

The machine was originally designed

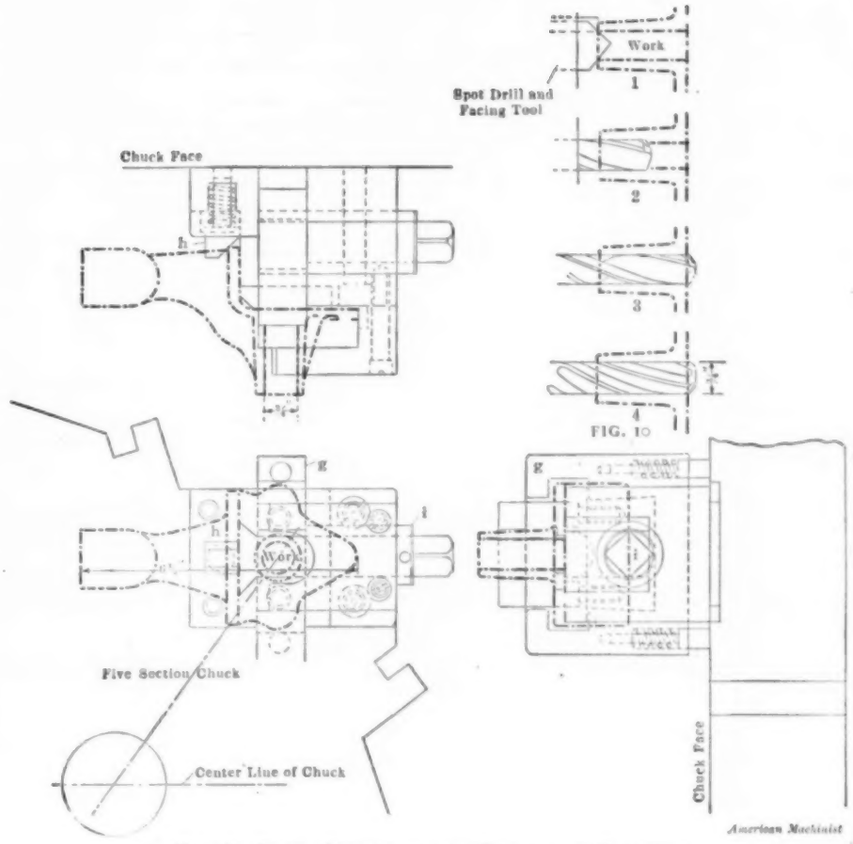


FIG. 10

Fig. 9. First Operation on Radius-rod Bracket

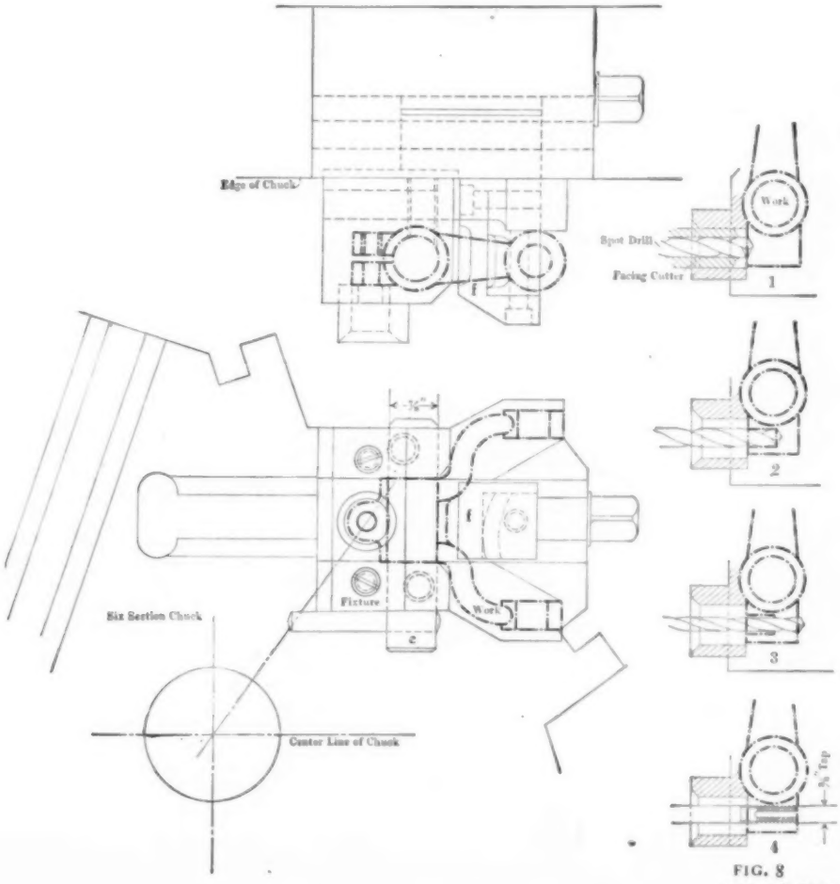


FIG. 8
American Machinist

Fig. 7. Third Operation on Clutch Forks

for brass work and is largely used in the manufacture of plumbers' and gas fitters' supplies, such as compression bibbs, valves, etc. In finishing such pieces as nuts of various kinds a double head machine is used and one piece in each side of each section of the chuck is inserted.

Operations on a Steering Knuckle

Still another automobile part is illustrated at *D*, Fig. 1, and a view of the holding fixture on the turret machine chuck is shown in Fig. 14. The shank of the piece is turned and threaded before being placed in this fixture, in which the hole through the body must be drilled and then counterbored from each end, the through hole having a diameter of ¾ inch, while the ends are enlarged to ⅞ inch.

The work is dropped into the inclined fixture, Fig. 14, and secured by two springing clamps *m* and *n*. There are four of these fixtures on the chuck and a double-head machine being used, there are three spindles at each side of the work.

The first pair of tool spindles carry spotting drills for spotting both ends of the body of the drop-forged knuckle. The second spindles carry ¾-inch drills, after which ⅞-inch spiral fluted chucking drills are run in to enlarge the holes.

Machining Die Blanks

At *E*, Fig. 1, a pair of blanks will be noticed which when finished will be used

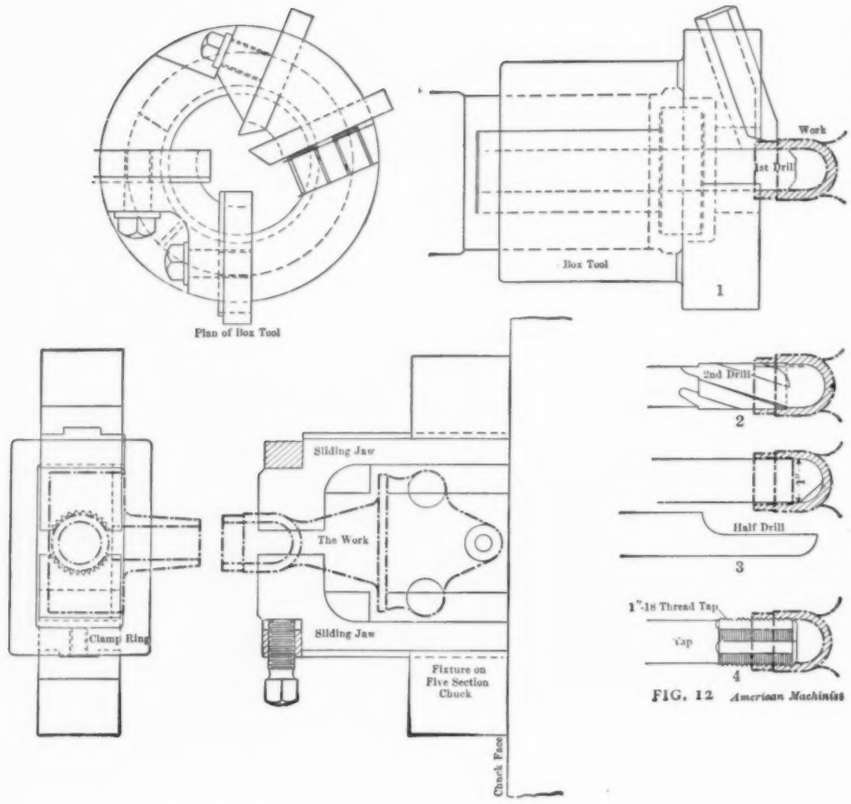


FIG. 12 *American Machinist*

FIG. 11. SECOND OPERATION ON RADIUS-ROD BRACKET

for pipe-thread dies. The operations on these pieces in the Prentice turret machines consist in drilling the large hole at the center and reaming it taper prior to threading. One of the holding fixtures for this job is illustrated in Fig. 15. Very little explanation is required. The work as machined on top and bottom and edges is placed upon an adjustable block in the fixture and clamped by the means indicated. Two headless screws at the ends locate the work endwise and in setting the fixture for a given job the lower block may be slid either to right or left to adjust it vertically for centering the blank properly. The inclined slots and the corresponding tongues on the moveable member give all the range of adjustment necessary. The fixtures are provided with round shanks and as will be noticed are secured to a face plate instead of a chuck. Five of them are mounted upon the face plate and a four-spindle single-head machine employed for the work.

First a drill is run through, leaving a little stock to be removed with a single-point tool in the second spindle, after which a roughing reamer in the third spindle reams the taper hole approximately to size and the finishing reamer in the fourth spindle completes the work.

AN INDEXING FIXTURE ON AN INDEXING CHUCK

In Fig. 16 is represented an indexing fixture for carrying a piece similar in general form to the part illustrated at *F*, Fig. 1. Referring to Fig. 16 it will be noticed that the holding fixtures are mounted upon a four-section chuck for a double-head machine and the work after each pair of spindles have been ad-

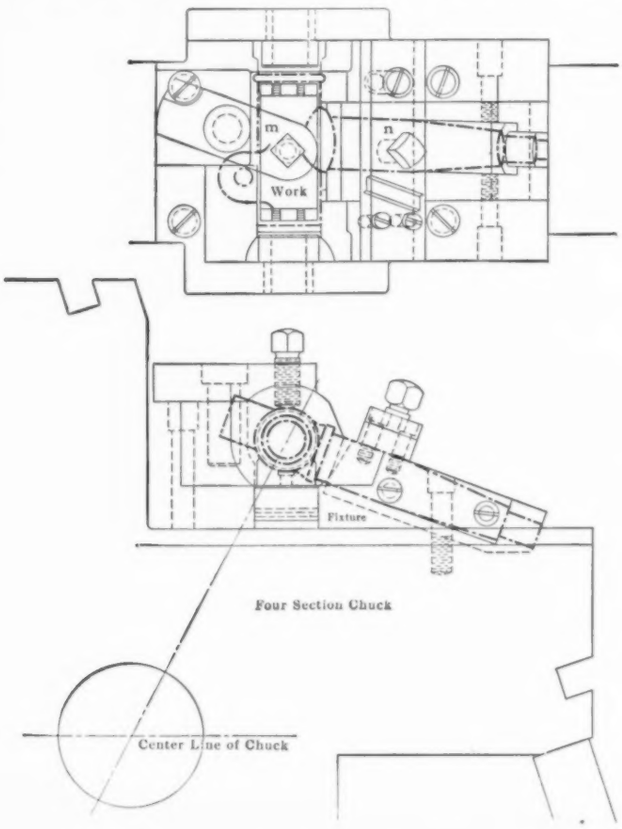
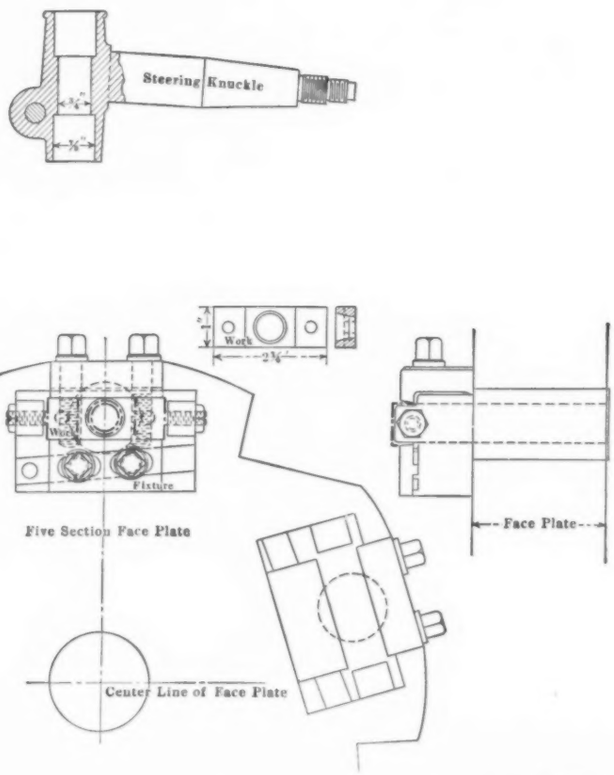


FIG. 14. FIXTURE FOR BORING STEERING KNUCKLES



American Machinist

FIG. 15. FACEPLATE FIXTURE FOR BORING PIPE-DIE BLANKS

vanced to drill opposite holes through the periphery is indexed on its fixture and the chuck then indexed also, to bring the work into position for the machining of other holes by the next pair of spindles.

Operations on Door Checks

In Fig. 17 a door-check body is illustrated at *G* and the fixtures for holding this piece while machining in the turret machine are illustrated in Fig. 18. The first operation consists in facing and turning end *A* and drilling and tapping the hole inside for the stuffing box; the fixtures, of which there are five, are shown attached to the face plate in correct position for accomplishing this first operation. The fixtures are rectangular, box-like affairs, having a series of screws upon the points of which the casting rests

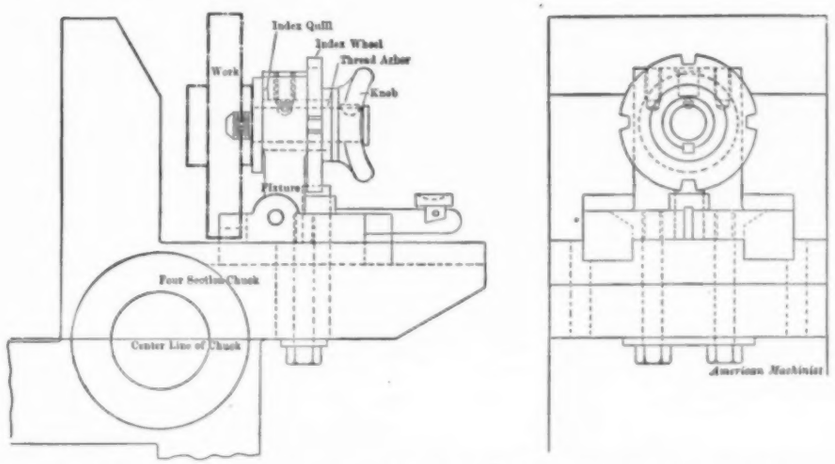


Fig. 16. An Indexing Fixture on Chuck for Drilling and Tapping Gas Fixture

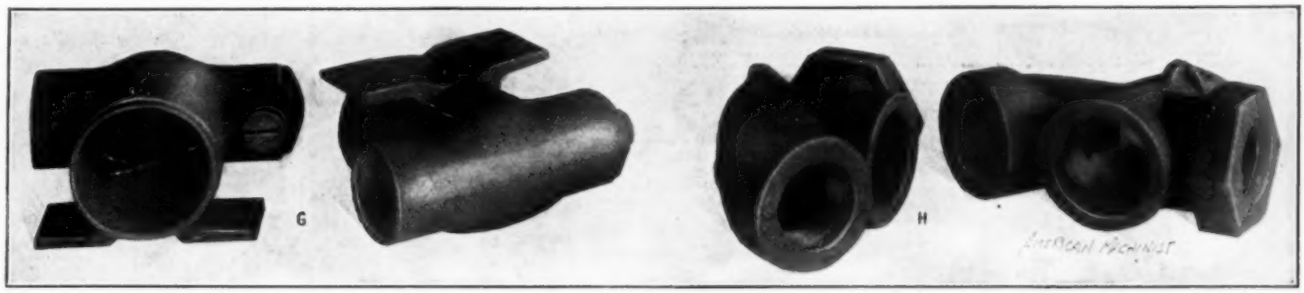


Fig. 17. Door-check and Air-brake Cock Bodies Finished on Turret Machines

securely, while the clamping is done by a swinging leaf *o* which is forced forward by set screw *p*. Leaf *o* has sufficient freedom in the fixture so that when screw *p* is run back the leaf will swing open wide enough to allow the work to be readily removed.

This type of fixture is so designed that after the first operation has been performed on the entire lot of pieces the fixtures may be turned over on end *q* to bring the work into position for the second operation, which consists in facing, reaming and tapping end *B*.

All operations on these turret machines are performed while the chuck or face plate is held rigidly with an indexing surface on its periphery in contact with a supporting bracket on the front of the machine bed. This index face is seen in different views in this article, and a special form of support is illustrated at *r* in Fig. 18.

Second Operation on an Air Brake Cock

The casting at *H*, Fig. 17, is an air-brake cock in which the taper hole has been finished before the piece is placed in the turret machine, where the end must be faced and the hole outside the taper must be bored out and tapped for the cap. Fig. 19 represents a face plate for a four-spindle single-head machine carrying five fixtures for holding these castings. The holders consist merely of taper plugs adapted to fit the finished holes in the work and having a shank to fit the hole in the face plate. At one side of the cylindrical shank an eccentric stud takes a bearing, and when this stud or plug is turned to secure the work the eccentric portion draws the taper holding plug back tightly and brings the casting firmly against the face plate. When the eccentric is turned in the other direction the work and plug may be withdrawn entirely from the face plate, the plug slipped out of the casting, dropped into another piece and secured again in the face plate. As with all the holding fixtures used on these machines, the arrangement is such that the operator has ample time to remove the work and put in a fresh piece, without stopping the machine. In fact he will attend to a battery of, say, four machines, which can be so timed that he can walk from one to another, removing finished pieces and

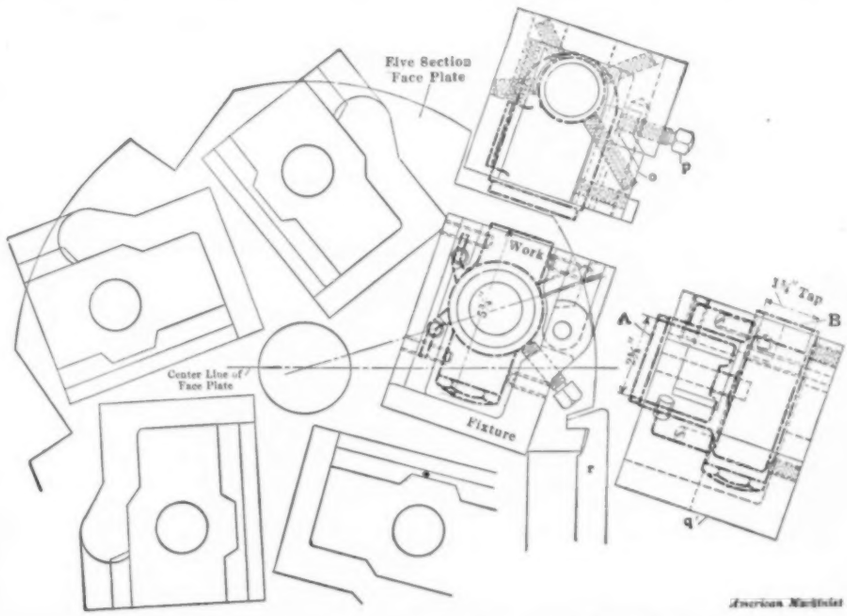


Fig. 18. Faceplate Fixtures for Machining Door Checks

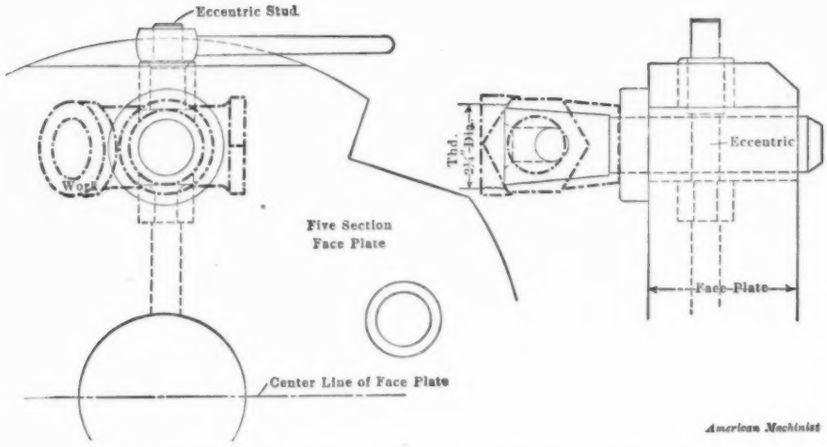


FIG. 19. AIR-BRAKE COCK CASTING ON FACEPLATE FIXTURE

lustrates one of the latest designs of this tool, and the general construction is also clearly shown in Fig. 22. One or more cutting tools may be used, as required. While the head is of a cylindrical form, this is cut out from the end nearly back to the shank, upon opposite sides, so that there is ample opportunity for all chips to fall clear of the tools and so avoid clogging.

The Swedish government is experimenting on the use of peat fuel for the state railways. On the Wexiö Light Railway peat has been used for five years without necessitating any change in the furnaces of the locomotives. It has resulted that a mixture of equal parts by weight of peat and coal, or of two baskets of peat to one of coal, answers best.

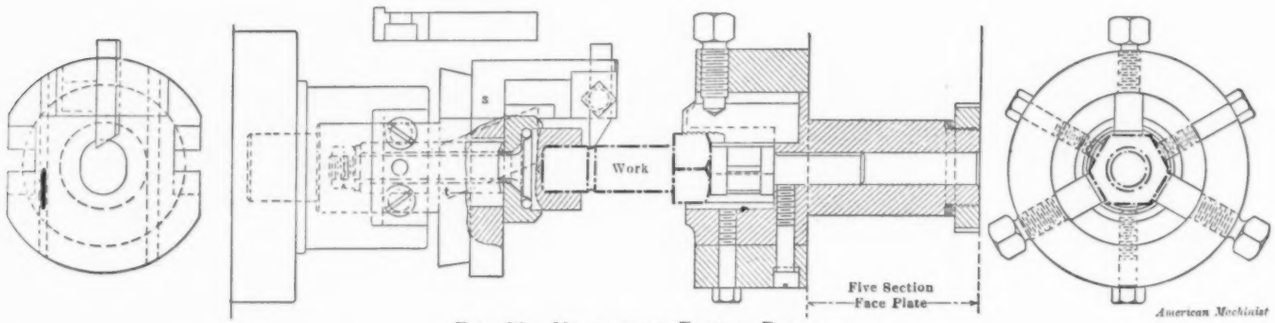


FIG. 20. MACHINING FORGED BOLTS

putting in new blanks, without the necessity of stopping any machine and without any section of chuck or face plate being presented empty to the cutting tools.

FINISHING FORGED BOLTS

A method of handling forged bolts or screws is illustrated in Fig. 20. This drawing shows the piece gripped by the hexagon head in a chuck having three serrated jaws closed by independent screws, while the body is turned and the blank faced under the head. Before running on the threading die the neck is cut at the end of the portion to be threaded and for this operation the outer end of the piece is carried in a revolving steady rest which as shown is provided with a ball thrust bearing. The necking down tool is a cross-feeding device, which our readers will recognize as a tool used quite extensively on the Prentice machines. The tool is carried in a slide *s*, which is fed laterally to the work by a cam or wedge-shaped piece, which when advanced longitudinally produces the cross motion of the tool holder. The four operations on the work are then rough turning, finish turning, necking down for the thread, cutting the thread. The face plate carries five of these holding devices or chucks, and the machine has a single head with four spindles.

BOX TOOLS

Reference has already been made to the form of box tool commonly used on this make of turret machines. Fig. 21 il-

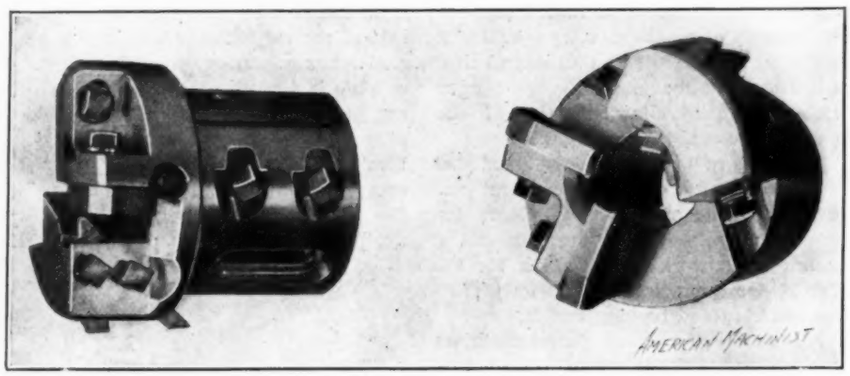


FIG. 21. PRENTICE BOX TOOL

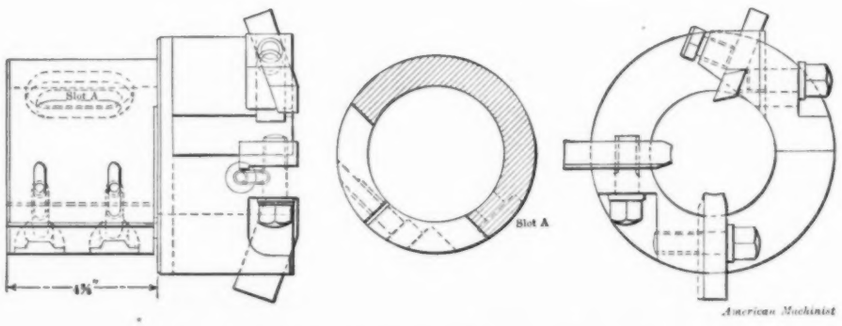


FIG. 22. CONSTRUCTION OF PRENTICE BOX TOOL

A Rolling Mill and a Little History *By P. S. Locke*

During a recent trip through a few of the western States I met a legal friend in one of the cities visited and was asked to look over a re-rolling mill, which owing to a triple failure had in some way gotten into his hands to straighten out.

The mill had been laid out, possibly by an undertaker, for it was a corpse when I saw it. Hadn't been run for over a year. Not being able to answer many of my questions relating to the operation of the plant, my friend called on Tom, who had during the last struggle, been a time-keeper and knew something of the running conditions.

The Mill and the Man from "Around Pittsburg"

It was started by some of the local people, who had listened to the siren voice of a man, name forgotten, who trailed in claiming to be from "around Pittsburg" and was overflowing with tales of the millionaires of that "neck-of-the-woods." Stock was quickly taken up, machinery was bought, including a whistle that carried the key-note of prosperity to the city's limits on all sides.

The Pittsburg man was better versed in stories of getting rich quick than running a plant, judging by his arrangement of the machinery, etc. A side-track from the local railroad ran in on the left side. Here they received their coal and scrap and loaded up for shipment. Ranging along the track, without any particular regard to order or availability, were several good-sized shears, scrap bins, sorting tables, and coal bins. The boilers, whether by accident or malice aforethought, were right next the coal bins. The engines were as near the boilers as circumstances would permit and gave evidence of some skill in their placing.

At this point start in methods that are not considered in the efficiency class. The rolls were placed at right angles to the side-track and with the long way of the building. The furnaces were on the opposite side of the building away from the side-track—all material and coal had to be carried over in wheelbarrows and trucks across the floor of the mill. The rolls were never stopped to suit the convenience of this procedure, so naturally the men, with never a recorded protest as far as I could learn, waited with stoical patience and the solace of a pipe, until opportunity opened the way for them to proceed. Tom's bit of history at this point revealed the fact that generally about 15 men at $1.75 per day were kept busy (?) at this work. Tom was asked if any other methods were ever considered. "Yes, sir, one of them overhead carriers was talked about but they thought it cost too much."

The finished product was stored on the same side of the building as the furnaces and had to be carried around the end of the building to load onto the cars.

The cutting shears, as mentioned before, were seemingly located wherever it was easiest to unload them, making long lengths of shafting and many belts, most of these without any covering to protect them from the weather also increasing the distance that had to be covered to reach the furnaces.

Tom informed me that the Pittsburg man was connected in some way with the firm from whom they bought their scrap and his brother, or cousin, was agent for most of the machinery installed.

Two years' operation started an epidemic of insomnia among the bank officials and brought on the resignation of the man from "around Pittsburg" and the closing up of the mill for a period of a year or more.

The Mill and the Banker's Nephew

At length local pride and public spirit became offended at seeing the great industry of the city idling away its time. A reorganization was brought about; money was again forthcoming—but no more from "around Pittsburgher." One of the largest subscribers for the new company had a nephew, recently graduated from a nearby technical school. He was made superintendent of the mill. A former resident of the city, who had boldly gone forth to face the world and at one time during his absence had held a minor position in a steel plant, was made general manager. The superintendent, primed with a college education and backed by his uncle, would brook no interference from the general manager. The latter, probably having learned to nurse a job during his journeying around, moved the office to one of the city's big new blocks where he could reign supreme, leaving the nephew to enjoy his suburban surroundings. A year and a half under this new management (so-called) again opened the eyes of the leading citizens and bankers and once more the mill took a vacation.

The Mill and the Lessee

Next a lease was signed with an outside party and arrangements made with the banks to cover some new machinery needed, there being enough capital available for running expenses. One of the new machines, designed by the lessee was a "portable saw" to be used to help out the shears and make lengths exactly suited to customers' requirements. A 75-horsepower motor and saw were mounted on a truck with wide-tired small wheels, requiring three horses to move it from place to place—horses could be had at any time, if there wasn't a funeral in town, from a livery stable about half a mile away. This new machine was very energetic—over 80 tons of odd lengths that evidently never came within the range of customers needs being on hand yet. One of the saws broke, nearly killing two men and knocking out one of the posts carrying the main line shaft, which ended its career. Some of the other improvements made by the lessee were along good lines, using motors for shears and saws, doing away with long lengths of shafting, belts, etc.

A little less than a year exhausted the running expense funds. The banks having already done their share, remembering former sleepless nights and not seeing any effective way of using the "new machinery" in their regular banking routine again made it necessary to close up the mill, which for some time had ceased to be the pride of the city, except when spoken of to strangers.

There was little that could be done to help the situation that faced my legal friend other than suggest the sweetening up, as much as possible, the losses his clients had to swallow.

It is one of the lamentable facts of business life, that such proceedings as the one given have a tendency to make capital, naturally timid from the start, more and more afraid of industrial ventures and this is not limited to the newer localities. It further emphasizes that absolutely essential combination—brains, experience and capital—if success is to be achieved.

In a paper dealing with lubrication and lubricants, presented before the American Society of Mechanical Engineers, it is stated that the value of viscosity as a distinguishing property of lubricating oil is recognized by all who have given attention to the subject but all are not agreed as to the extent of its practical reliability. Archbutt suggests that the quality of oiliness or greasiness is nearly of as much importance as viscosity. Although there is no precise method whereby oiliness can be determined, it is not difficult to recognize it nor to distinguish the marked differences in this respect shown by different oils and greases. Archbutt calls attention to the fact that at very low speeds the friction of a cylindrical journal should be proportional to the viscosity of the oil; but at higher speeds, and consequently increased temperatures, the relation of friction to speed ceases; the viscosity is diminished with a corresponding change in the carrying power of the journal. While fully appreciating the value of the information to be obtained by chemical analysis, Archbutt insists that the oiliness of a lubricant is of especial importance under heavy loads and high speeds.

An Effective Process for Burning Fuel Oil

This process developed by the Gilbert & Barker Manufacturing Company, Springfield Mass., while well known to many users, has, I understand, never been made the subject of an article in any trade or other journal. The field of its usefulness is so large and increasing so rapidly that I cannot cover all the details but will give examples of appliances of interest to readers of the AMERICAN MACHINIST and data comparing it with other fuels.

Fuel oil is the residuum left after all the other higher priced products such as kerosene, naphtha, gasolene, vaseline, etc., have been extracted from the crude oil as it comes from the oil wells.

Fig. 1 shows the original plant installed at the General Electric Company's works at Pittsfield, Mass., but which has since been considerably enlarged.

The air compressor and oil pump are in the center of the halftone and at the back. From left to right the appliances shown are; a large die and pack hardening furnace; next it is a smaller die-hardening furnace and to its right a furnace for treating high-speed steel. In the center and to the front in the halftone is a furnace for general work and beside it an oil tempering bath. To the right are three cylindrical furnaces such as are used for lead and cyanide hardening.

A Typical Plant

The storage tank is situated outside of the building in any convenient place and is buried below the surface of the ground to avoid fire risks. The sizes of these storage tanks vary from a single tank with a capacity of a few barrels to batteries of tanks each of which has a capacity of 10,000 gallons or more. From the top of the tank runs the filling pipe, a gage pipe for ascertaining at any time the quantity of oil on hand; a pump pipe to the bottom of the tank for removing water or sediment and a vent pipe. Under ground, and close to where the vent pipe joins the storage tank, is a fire arrester which effectually prevents the contents of the tank from taking fire should the surrounding buildings burn and the vent pipe be broken off. The fire arrester consists of a series of perforated plates one above the other and their action is similar to that of the well known Davy safety lamp used by miners.

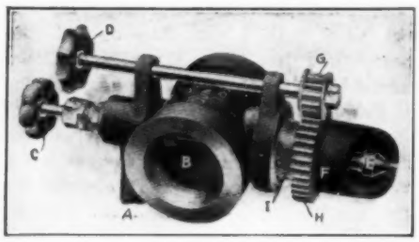


FIG. 2. LOW-PRESSURE BURNER

Within the building is the rotary air compressor *A* which is placed at any point where it can be conveniently belted to the shafting. It is equipped with a receiver *B*, provided with a safety valve. In this receiver the air is maintained under a working pressure of about 2 pounds. From the receiver the air is led by pipes to the various burners. A rotary oil pump is driven by sprockets and chain from the rotary air-compressor shaft and draws the oil from the storage tank and any excess is returned by gravity to the tank, after passing a relief valve on the oil service pipe. The oil is maintained in the system at a pressure of 5 pounds.

This belting of the oil pump to the air pump is a clever and efficient way of overcoming what might otherwise be a source of serious danger. For should the air-pump belt break and it be thrown out of commission, the oil supply pump stops simultaneously, preventing any flooding of unatomized oil to the heated furnaces and possible injury to plant or operators. This method has been commended by the fire underwriters.

By means of an automatic valve any oil remaining in the system when shut down drains back to the storage tank.

The Burner

Fig. 2 shows the burner in part section. The oil at 5 pounds pressure enters through the pipe *A* and its quantity is controlled by the valve *C*. The air enters through *B* at a pressure of 2 pounds. The nozzle consists of two main parts—*E* through which the fuel oil passes, and the sleeve *F*, whose position controls the quantity of air supplied. The rear end of *F* is threaded to fit the screw *I*, and its position is altered at will by means of the handwheel *D* and the gear and pinion *G* and *H*. As the sleeve *F* approaches the cone on *E* the quantity of air admitted to the burner is reduced but the velocity is maintained. The oil and air emerge

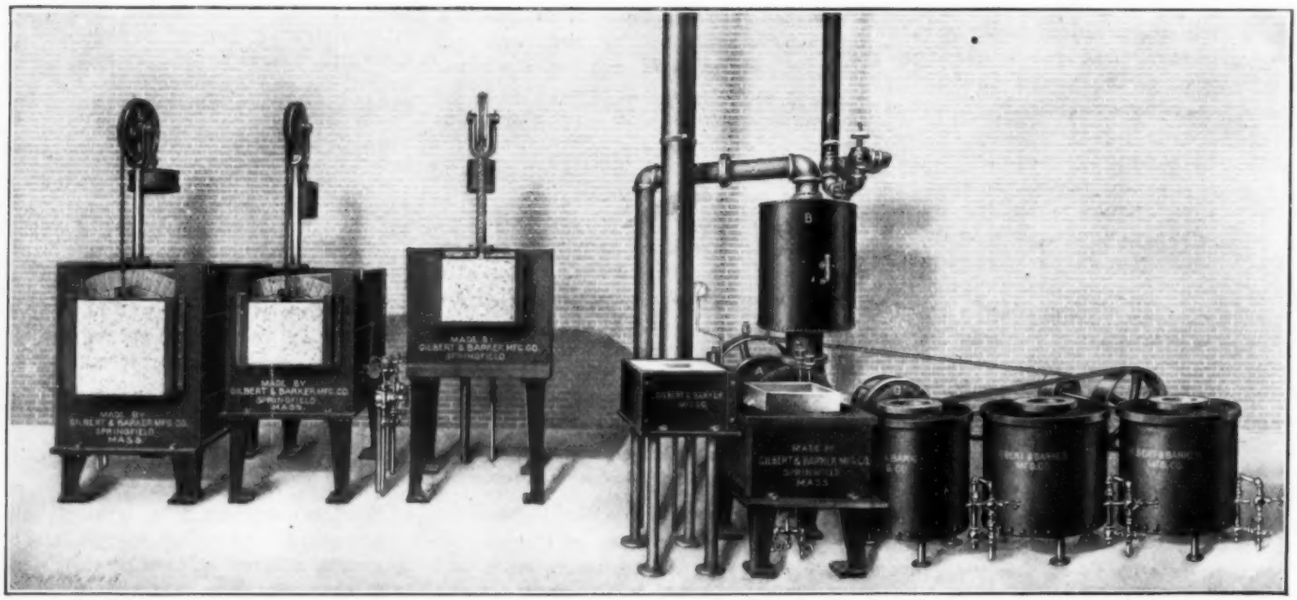


FIG. 1. AN INSTALLATION AT THE GENERAL ELECTRIC COMPANY, PITTSFIELD, MASS.

from the burner in a spray so fine that it resembles fog, is practically a gas and burns without dirt, smoke or ashes.

Regarding Economy

The question of the economy of fuel oil over coal or gas is a question of the relative costs of these fuels at a given point and also of the type of furnace in which the fuel is to be burnt. Taking a ton of coal as a fixed unit there are cases where 50 gallons of fuel oil will equal one ton of coal; again there are instances where it has taken as much as 213 gallons of oil to do the work of a ton of coal. A fair estimate would place 100 gallons of fuel oil as the equivalent of a ton of coal.

Fuel oil sells for from 2¾ to 3 cents per gallon in the East. The price of coal is only too well known to all who have to pay coal bills.

In the average forge 100 gallons of oil would equal a ton of coal and at the higher rate of cost this would be equivalent to coal at $3 per ton, a price at which, it is safe to say, no coal can be bought in the East. Further, if one adds to the first cost of the coal its handling, dirt and inconvenience, the lack of steady heat, the removal of the ashes and the ohter annoyances attendant upon its use, even at greater first cost fuel oil would be the more desirable.

A Few Specific Instances

In one large shop in Massachusetts where textile spindles are made, they have a number of fuel-oil furnaces which replace coke-fired furnaces. Formerly, each one of these furnaces burned 31 cents worth of coke in a 9-hour day. Each forge man had a helper whose pay was $1 per day. The intermittent heat of a coke or coal fire is well known so I merely call attention to it. These coke furnaces, costing for fuel and helper, $1.30 per day, and giving irregular heat, were replaced by fuel-oil furnaces, which give a steady heat at all times, require no helper to nurse them and use only four gallons of fuel oil, costing 12 cents per 9-hour day, a clear saving in working expenses of $1.19 per day.

In another plant, also in Massachusetts, they were using city gas at $1.40 per 1000 feet. They had 36 gas burners, each using 140 feet per hour. A trial fuel-oil plant was erected and it was found that 0.6 gallon fuel oil would give the same results as 140 feet of city gas, these costing 1.8 cents and 19.6 cents, respectnvely. These are not isolated cases, but everyday practice. If I were to give some of the figures I have no one would believe me.

The Effect of the Fuel-oil Heat on Steel

The heat from fuel oil properly applied in an efficient furnace does not affect steel as does direct contact with burning coal containing, as it does, more or less sulphur and other impurities. If the air is properly regulated there will be practically no scale and even when scale is formed it seems to be of a different character from that formed by a coal fire as it is not so destructive to the dies. One large firm making drop forgings asserts that the saving in die repairs, formerly attributable to scale formed by coal fires, amounts to several dollars a day.

Worcester School Ma'ams and Industrial Training *By Entropy*

As a general proposition I should expect to be mobbed if I attended a convention of school teachers, but I happened over in Worcester the other day when Mr. Draper, Commissioner of Education of the State of New York, spoke before such a gathering on the subject of Industrial Education. What Mr. Draper had to say was so much in line with what has been said many times in the columns of the American Machinist that a very brief review will suffice. The remarkable thing is that public opinion, and school teachers' opinion has been so changed in the past few years. If Mr. Draper had said these things even five years ago, and gotten off the platform with the same amount of hair that he brought on, it would have been a marvel.

The radical statements from a Worcester point of view were these: The imperative needs of the shop for skilled workers has led a few shops and a few philanthropists to start isolated schools for the teaching of trades. The effort has been so spasmodic and disconcerted that the net result is zero.

Manual training has gone around the real question, and has played on the misguided ambitions of youth. It would avoid the smut and grime which comes from the handling of tools and machinery. It has been handled entirely by theorists rather than the mechanically skilful.

The trades themselves have become more and more incapable of training children, and the children have been told day in and day out, by implication at least, that unless they earned their way by brain work rather than hand work they would miss the goal to which all American children should turn.

The schools have been submerged in educational theory which seems better suited to some other world than to this. It has anticipated the aëroplane, and while heavier-than-air it has flown among the clouds.

The tendencies of the people as a whole are democratic. Everyone must have the same chance whether in the direction of the intellectual, professional, cultural or industrial. The little of industrial training that has hitherto appeared in our schools has been, when brought to light, merely preparatory to college work, not an end in itself. It has discriminated against the people who work with their hands in spite of the fact that the children of the latter constitute by far the larger part of their pupils.

Experience has shown that manual training school teachers, without actual trade experience do not and cannot successfully solve this great problem, and that progress will be necessarily slow as new teachers must be provided, a new set of text books will have to be written, and the subjects will have to be taught in a sympathetic and systematic manner.

Hurrah for Mr. Draper! The whole bunch of school ma'ams, male and female alike, had to sit and hear him out.

Training Apprentices in New Haven

The manufacturers of New Haven, Conn., and the Chamber of Commerce of that city, are endeavoring to make a practical trade school out of the Boardman Manual Training School for the training of apprentices in the various lines of industry to be found in that vicinity. There seems to be an awakening to the realization that in order to have skilled mechanics it is necessary to train the apprentices, and as the school mentioned has been established for a long time, it ought to prove a valuable foundation for this work.

Of 8⅔ million dollars' worth of automobiles exported from the United States in 1909, 7¾ million went to foreign countries and $880,780 to its noncontiguous territories. Of the exports to foreign countries, nearly 2½ million dollars' worth went to British North America, 2 million to the United Kingdom, $846,136 to France, $494,238 to Mexico, $337,414 to the West Indies and Bermuda, $303,452 to British Australasia, $240,453 to South America, $224,068 to Italy, $181,087 to Germany, and $209,731 to various countries of Asia and Oceania.

An English Drafting Room and Efficient Cost System

Division of Work and Fixing Responsibility the Main Features

By I. William Chubb

The firm of Herbert Morris & Bastert, Ltd., Empress Works, Loughborough, England, are well known as specialists in crane work, both hand and electric. At present they employ more than 500 men, and a further 50 are employed outside in erecting their various productions. This represents the growth of about 10 years, for although the firm was actually in existence some 14 years before that, it was in a comparatively small way in Sheffield. The foundation of the business was their worm-gear pulley-block, and natural developments have led by various stages to the production of hand cranes and electric cranes up to 100 tons capacity.

One comparatively recent introduction is an electric crane which is intended for small shops or bays where something quicker than a hand crane is wanted, but where a high-priced, fully equipped electric crane would hardly pay its way. The lift only is electric, the traveling motions being by hand on ball or roller bearings, for it will be found that waste of time with hand operation is not so much in bringing the crane into position as in raising or lowering the job. The idea is that the fitters can be given a crane for their own use, the motions being controllable from the floor, so that the men help themselves as required without laborers and without a crane driver. In the present article, however, it is not the production side of the concern with which we wish to deal, but rather with some features of the cost and drawing-office system.

Two Separate Drawing Offices

For the preparation of drawings, two practically separate offices have been organized, one for electric, the other for hand cranes. The electric drawing office has its own staff with chief engineer who is responsible for the designs. The hand-crane section is controlled by a head who has two assistants; one is responsible for current orders, while the other looks after standardizing, new designs, etc., and keeps the organization uptodate. In the following we are chiefly concerned with this office, which, as already noted, is worked in two portions.

Verbal Orders Are Avoided

Throughout the organization the idea is to avoid verbal orders or directions. In fact they possess no sort of authority. Thus all instructions for current orders come up to the drawing office in the shape of a form *A* from the general office giving full particulars of the order, and such details as maximum dimensions to meet freight considerations, directions as to the erection of the job, details as to material already appropriated or to be ordered—everything being set out in tabular form, together with special instructions as to parts to be particularly noted on drawings, so that all such matters can readily be picked out by the person concerned. This instruction sheet is then handed over to the current-order assistant, who gives out the work according to his judgment, the whole of the drawings being made by men under his supervision. The drawings, after being checked (there being a checker to each department), are, of course, traced. The tracing is also checked and handed over to the assistant for examination again, and finally brought to the head of the department for passing. As far as is possible both drawing and tracing are checked by the same man. The tracings form the permanent record, the drawings, made in pencil only, being destroyed as soon as traced.

To get a print from any tracing a special order Form *B* is used, which has to be signed by the head of the department ordering. Whatever the department, the same form is used, and in any case it comes to the drawing office to be passed by the chief draftsman. When the tracing has been finally checked as correct, a card is made out, this card being filled in from the order form, so that it becomes an instruction to the printers, who return it with the print. No such print is made unless the order bears the signature of the head of the department, and an order cannot be made out for printing until the tracing itself has been finally passed.

The order Form *C* shows the depart-

INSTRUCTIONS TO DRAWING OFFICE. *Page*.....

Order No. ..... Corres. No. .....

	For Approval Drawing	For Works Drawings
Date sent to D.O.		
Documents (If there are any D.O. Calculations return to G.O. with Documents).		
	Shew:-	
Special Instructions.		
Drawings to be ready		

No part of this Order is to exceed ..... in length or ..... in width
Who erects ? ..... NAMEPLATES ? .....
Has any material been appropriated for this Order ....
What material has D.O. to requisition ? ....

Particulars of Order.

American Machinist

Form A. Current Order Instruction Sheet from Drawing Office

Date 19C

Order to D.O.

Please supply ..... print of .....
..... With ..... margin.
For .....

Signed .....
Order passed .....
Passed for printing .....

American Machinist

Form B. Order Blank for Print from a Tracing

Consec. No. 11999 Date ordered 19C
1 ..... print of .....
Margin ? .....
Particulars noted .....

Date	Sent to	For	Signed
	M		
	M		
	M		
	M		
	M		

Passed for printing ..... Card passed for filing .....

American Machinist

Form C. Blank Used to Indicate Department Requiring Print

ment for which the print is to be prepared. The card is sent with the tracing to the printer, who returns it with the print, having previously signed the card. Then, when the print has been passed by the drawing office, it is forwarded with the card to the person ordering, being recorded in the print-record book on the way. A receipt for the print is taken on the same card, which is then returned to the drawing office. An order card is made for each print and thus gives the whole history of that print. The print-record book is examined every morning, so that if for any reason the card is not returned at the right time the cause can be discovered. Instructions for standard work are typewritten from the general office and passed to the other assistant, to go through much the same routine. The head of the drawing office has a box of cards which are divided into jobs in hand, jobs stopped or hung up, and unallotted. To see how the work is progressing he goes through all these cards at least once a day and notes daily on each card the condition of the job.

Card Index for Tracings

The card index system is used for all

Drawing Office TIME CARD.

NAME ..... DATE 190

Order No.	Drg. No.	Particulars of Work.		Hours.

CORRECT ..... Total Time ...

American Machinist

Form D. Drawing Office Time Card

drawings, or rather tracings, which, as stated, form the permanent record. The index is in three sections—numerical, classified, and correspondence numbers of customers. The standard drawings, which are known as "E"-sheets (quite a feature of the office), consist of a boiling-down of all standards. All drawings are of standard size, each different size being denoted by a letter; the *L* size, 20½x15 inches, being as far as possible used for general work. The others are multiples or sub-multiples of this, and the E-sheets are the smallest size used. In this size one sheet is devoted to each detail and gives dimensions for all sizes of that detail. It is the method of the firm, as soon as any given line has been standardized, to split the details into E-sheets. Being for purposes of record and office use, these are not put through the ordinary index system, but are arranged alphabetically according to the name of the detail.

A specification book contains a full list and particulars of parts for any given complete machine. Other E-sheets contain tables of information, diagrams and charts. Each draftsman has a copy of those E-sheets that he is likely to require daily. In the classification index the drawers are divided into the different manufactures of the firm, as cranes, trolleys, runways, blocks, etc. In the correspondence index each firm is known by a number being given on all sheets of instructions. Each index card shows all drawings made to jobs ordered by the firm whose correspondence number it bears, so that if, for example, an additional order be received from any firm, the number of that firm can be looked up and the drawings found immediately.

The Pattern Index

In addition to the drawings index there is a pattern index, which is classified according to the name of the article. If necessary, the card also bears a sketch, to enable the pattern to be the easier traced by the draftsman. All patterns have numbers and whenever a pattern is altered it is given a different number.

..... 1909.

Corres. No. .....

Order No. .....

Mr .....

The following Drawings are sent herewith:

General Arrangement for Customer's Approval .....

General Arrangement and Details for Shop .....

Drawings for Pattern Shop .....

Notes:- .....

Form E. Blank Accompanying Prints When Sent to Commercial Office

Pattern numbers, in all cases, appear on the casting. The original pattern card records the change of number and the number it has been changed to.

To look after this system there is an index clerk who is assisted by two lads. These lads are usually taken fresh from school and kept about six months on this sort of work; that is, in attending to office requisites and in particular to the strong room where tracings, etc., are kept. They are then put to a drawing board and finally develop into draftsmen.

Drawing-room Time Cards

In the working of the drawing office, each man fills in time cards Form *D* to show the work he is on and time taken. These cards are collected daily, looked over by the head of the department and sent to the cost department. In this way it is possible to know accurately the cost of every tracing, whether preliminary or otherwise, each item being kept separately. In addition, columns on the card indicate inspection or supervision and time spent thereon by the head draftsman. The drawings supplied to the shops are prints. Standard drawings are pasted to boards and varnished. Drawings of special work are simply pinned. Pressed boards are used, without battens of course, so that they can be placed together without damage to one another.

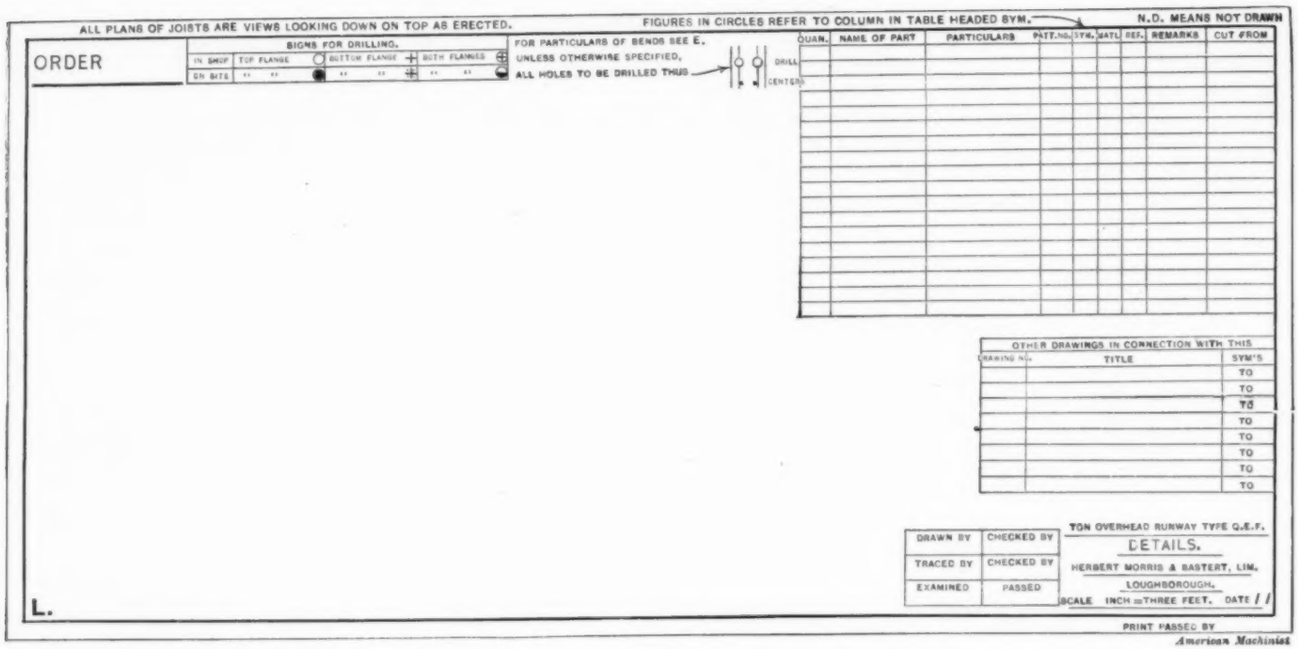
The blueprint room has the usual electric printing frames, washing baths and so on, the hot water pipes which heat the office being duplicated in the drying department, so that prints may be dried quickly in the winter.

The Calculation Sheet

Another detail worthy of mention is the drawing office calculation sheet, which measures about 12x9 inches. At the top the correspondence number of the customer, the order number, the name of the draftsman, the job, and the part of the job to which the calculation refers, are all shown, the remainder of the sheet, on which calculations are made, consisting of squared paper with ¼-inch squares. These calculation sheets, and, in fact, all documentary matters, are filed according to the firm and date, and all such details relating to a single job are put together and kept permanently. When the job is ready to be sent down to the commercial office, a special Form *E* accompanies it which gives a list of drawings, notes, etc. A blank is left on the top left-hand corner, enabling the cards belonging to the job to be clipped in position and yet not obscure the particulars given on the form.

Standard Tracing Sheets

One of the most attractive features of the office system is formed by the standard tracing sheets, of which four sets are at present in use. The system is being developed, as it has been found to



FORM F. SPECIMEN SHEET FOR TRACING SHOWING STANDARD PRINTED HEADINGS

save time considerably. A sample sheet, Form *F*, shown much reduced, shows that these tracing sheets are printed ready for use with a table for filling in the names of parts, together with their quantities, pattern numbers, symbols, and so on, while another table gives a list of drawings required in connection with the job, and yet a further table shows the set of men in the office who have been responsible for the work.

These tracing forms are used in the following way: First, the draftsman has to set out the pencil drawing so as to avoid the tables. He does this easily, working on semi-transparent paper, with the tracing form below it. In this way he is enabled to write in pencil all the tabular details connected with the job. The tracer of course works in the opposite way, the pencil drawing being below and the tracing sheet above. To give an idea of the saving of time effected by this system of tabular sheets, it may be stated that whereas the time on an average for making a tracing in the ordinary way worked out at about five hours, under the new system with the tabular sheets it is about three hours. In addition to the saving of time, there is the more important fact that the same thing is found always in the same place on different tracings, an advantage which the works manager will readily appreciate. All parts have a symbol, which is marked on the drawing for position, even if the part itself is not shown, the idea being that nothing must be left to the imagination of the workman. All views are set out to a standard form, plans, for instance, always being views looking downward on top of the job. These tracing sheets are also arranged so that the prints may be used readily for a number of purposes, margins being cut off or allowed to remain according to circumstances. For instance, a general-arrangement drawing would have, in addition to the ordinary top margin, another one bearing the words "Red letters are erection marks, which must be painted on parts in shop." This, however, would be cut off if the drawing were merely a proposed arrangement to be submitted to a customer, and a regular margin would be left still showing, which would bear on the top the words "The firm supply only the parts colored." A system of symbols used to indicate drilling operations, whether in shop or on site, will be seen at the top of the Form *F*.

"PARTICULARS OF ORDER" SHEETS

Turning to the costs system, on the receipt of an order, say for a hand crane, three "particulars of order" forms are filled in. The first two give every variable item which it is necessary the works

CORRES. No..... Page 1

PARTICULARS OF ORDER FOR HAND CRANE.

CUSTOMER'S FULL NAME AND FULL ADDRESS:
.....
.....
.....

ORDER No.....
DUE FOR DELIVERY.....19....
DATE THIS SHEET MADE OUT.....19....

One.....Ton Type.....Crane
Span.....ft.....ins.
Runway to floor.....ft....ins.
To suit rails.....ins. wide. Tread of tramwheels to be.....ins. wide.
.....Joist.....x.....x.....lbs. per ft. Our Sec. No. S.....
.....ft.....ins. long. Cut from.....
.....
No. of Longitudinal shaft brackets.....
One Longitudinal Shaft.....dia. x.....ft.....ins. long.
Cut from.....
Distance available between centre of tramwheels and nearest side obstruction
.....inches.
Load Chain.....″ dia. x.....′.....″ long
Hand Lifting Chain.....″ dia. x.....′.....″ circ.
Hand Travs. " .....″ dia. x.....′.....″ circ.
Hand Travelling Chain.....″ dia. x.....′.....″ circ.

DOCUMENTS ACCOMPANYING:—

1 Drawing No..... 1 Drawing No.....
1 Drawing No..... 1 Drawing No.....
1 Drawing No..... 1 Drawing No.....

Other information and particulars to be put on Works Copies of this Order.

Special Material Required —

Date Ordered.....

Received from G. O..... Sent to Works..... Checked.....
Passed.....

FORM G. PAGE 1 OF PARTICULARS OF ORDER

should note, all other details being shown on standard drawings. In fact, the forms are so drawn up that the blanks left relate to the only variable parts in a crane. Thus special drawings are necessary only when standards will not come in. Form *G* is self-explanatory.

The second sheet, Form *H*, consists of 29 or 30 questions (only 10 being shown) which have to be answered in the commercial office by the man who is responsible for the order, the object being to deal with every contingency, commercial or otherwise. The third sheet, Form *I*, is for forwarding and despatch. It is, in fact, sent to the forwarding department to determine the route, necessary consignment notes and labels being sent from the office. The two front sheets are sent to the specification department. This is used as a sort of half-way house between the office and works, each of which goes to it when in difficulty or doubt. The works is a technical department only and has no dealing with customers. Conferences are, of course, held between the two sides, technical and commercial, so as to keep each properly in touch with the other. The duty of the specification man is to put the matter in form for execution in the works, the matters being repeated as required on works copies of the first "particulars of order" sheet, together with any special notes on that sheet, while the second or questions sheet eventually finds its way to the costs department. All parts of these cranes are kept in stock and only such shop processes are permitted as are required on any special parts of the particular crane, no other labor being allowed to be charged.

CORRES. No..... Page 2.

PARTICULARS OF ORDER FOR HAND CRANE.

NAME..... ORDER NO.....

1. Will tram wheels and pinions clear bridge rails and their fixings?.....
2. Will the crab or T.P.B. clear the longitudinal sprocket wheel?.....
3. Will longitudinal sprocket wheel clear all obstructions?.....
4. Has Crane to be made specially?.....
5. On what account.....
6. What is distance from top of rail to nearest overhead obstruction.....ft.....in.
7. What is distance required from top of rail to nearest overhead obstruction...ft....in.
8. Has Customer approved of our general arrangement drawing?.....
9. Have we made any arrangement with Customer for testing?.....
10. Have we to ask Customers to advise us when goods are delivered so that we may send our men to erect?.....

Checked.....
Passed.....

FORM H. PAGE 2 OF PARTICULARS OF ORDER

CORRES. No..... Page 3.

PARTICULARS OF ORDER FOR HAND CRANE.

NAME..... ORDER NO.....

To be forwarded by.....Railway to:—

Special Notes:—(For General Office use only).

Invoice as follows:—
One.....ton Type.....
Hand Overhead Travelling Crane,.....ft.....ins. span £

Erecting Overhead Travelling Crane ..... £
(To be invoiced separately)

TERMS:.....

Checked.....
Passed.....

FORM I. PAGE 3 OF PARTICULARS OF ORDER

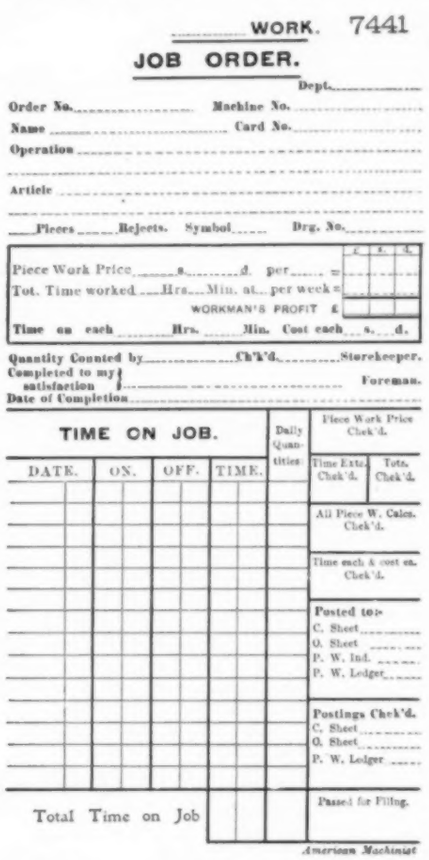
Job Orders

Job orders are made out on special cards, the colors of which, red, white or blue, indicate varying degrees of urgency. A sample card is shown in Form *J*. It will be noticed that on each card details of piece rates and time occupied are given, together with a complete set of blanks to show the checking of the job in every particular.

All the documents necessarily go first to the stores, where the parts are assembled from stock, or, if the parts are not in stock, the specification department has to be advised to make the necessary order. But if any special work is really necessary, this has been foreseen when the first "particulars of order" form was made out. Castings wanted are ordered and duly recorded as to quantities, balance, etc., any new pattern wanted being ordered in the same way. The pattern order card shows (Form *K*) in the top half the order number, pattern number, the drawing number, symbol number, whether new or altered pattern is wanted, the sort and quality of pattern, date when the order card was issued to the shop, who is to be advised when the pattern is finished; then, for the purpose of the pattern shop, the lower half of the card indicates the workman, total cost, number of hours worked, rate paid, job-card number, any remarks that seem to be called for by the work, and the date of finish of pattern.

Despatch Sheet

Special despatch sheets are drawn up and revised at least once a week regularly by the works manager, who fixes dates for despatch to which the foremen have to work. Any jobs not definitely allotted as to date are put at the bottom and nothing is put in hand unless it is on the despatch sheet. Trackers are employed to see that all the material required is forthcoming by the date, and from the despatch sheets the job cards are assorted according to operation, the guiding principle of the card being at once carried into operation. These cards are placed in pigeon holes formed on a revolving vertical cylinder, to which the foremen go when they want work. Any cards remaining in the box show what work remains to be done, and if all are removed from the box it is of course obvious that, as far as this department is concerned, at any rate, all the work on order is in hand. The drawings necessary cannot be obtained without the job card being shown.



_____ WORK. 7441

JOB ORDER.

Dept.

Order No. Machine No.

Name Card No.

Operation

Article

Pieces Rejects. Symbol Drg. No.

Piece Work Price s. d. per = £ s. d.

Tot. Time worked Hrs. Min. at per week =

WORKMAN'S PROFIT £

Time on each Hrs. Min. Cost each s. d.

Quantity Counted by Ch'k'd. Storekeeper.

Completed to my satisfaction } Foreman.

Date of Completion

TIME ON JOB.

DATE.	ON.	OFF.	TIME.	Daily Quantities

Piece Work Price Chek'd.

Time Extn Chek'd. Totn. Chek'd.

All Piece W. Calcs. Chek'd.

Time each & cost ea. Chek'd.

Posted to:-
C. Sheet
O. Sheet
P. W. Ind.
P. W. Ledger

Postings Chek'd.
C. Sheet
O. Sheet
P. W. Ledger

Total Time on Job

Passed for Filing.

American Machinist

FORM J. SPECIMEN JOB-CARD FORM

Specifications and Cost Sheets

The various parts or components of each order are entered on specification sheets, each in the center giving details of the parts, flanked on one side by columns to show weights and prices of materials, and on the other side, the operations, time worked, and cost of labor generally. These specification sheets eventually form the finished cost sheets, the labor side being worked out from the job cards, and are extended on the cost sheet. This is divided according to big components of the crane. Oncost burden, ascertained by a separate set of books, has as its basis the works returns, the oncost for each department being shown separately. Diagrams are kept recording about 109 different oncost charges, values being ascertained monthly, and the average for 12 months used on the cost sheet. Thus the total labor, and oncost added to the material gives the total cost. The sheet showing this is compared with the price estimated.

PATTERN ORDER CARD.

ORDER No.____PATT. No.____DWNG. No.__SYM. No.___
NEW or ALTERED PATTERN_____
SORT and QUALITY of PATTERN_____
DATE THIS CARD ISSUED TO SHOP_____19___
WHEN FINISHED ADVISE Mr._____
MADE_____WORK by_____for £ :
IN_____HOURS, JOB CARD No._____RATE_____
REMARKS_____
PATTERN FINISHED_____

American Machinist

Form K. Patten Order Card

It may be mentioned that although all these forms have to be filled, they do not act to handicap an order. Any standard crane can be got out on the same day that the order is received. If necessary, the system is broken, but only if necessary, the idea being that the system is made to facilitate despatch and not to hinder it.

Repetition Principle

The repetition principle maintains stocks, the average of sales being taken for a period and used as a basis to determine the minimum stock to be kept. The stock required is calculated on a three months basis. Once a week the stock is taken, and the head storekeeper has to note any articles below minimum number. The stores keep a specification book which gives all the technical details regarding parts of everything made, and all the information necessary to identify parts. Assembling sheets are also prepared, the whole being made out according to the number required to maintain the specified minimum stock. In this way it is impossible to run out of stock without three months notice of the fact that stocks are diminishing being kept before the storekeeper all the time. Another detail of the works is a standard operation book, which shows the operations and their sequence for every part made. Trackers follow the sheets through the various departments to insure that the work shall be completed according to requirements.

Automobile Practice in the Chadwick Engineering Works

The Chadwick automobiles are among the highest priced cars built in this country. The cylinders are water jacketed but as the jacket is of copper, screwed and shrunk into place the molding of the cylinders is a comparatively simple proposition and trouble with misplaced jacket cores is, of course, entirely absent.

The cylinder shown in Fig. 1 is first rough bored on a vertical boring mill in the ordinary way. Instead of seasoning in the usual way the cylinders are then heated in a wood fire to about 600 degrees Centigrade equal to a good red heat, they are retained at this heat about two hours and then allowed to cool with the fire.

A second roughing cut is then taken, followed by a finishing cut; they are then finally finished by grinding. The pistons are ground 0.002 inch smaller than the cylinders.

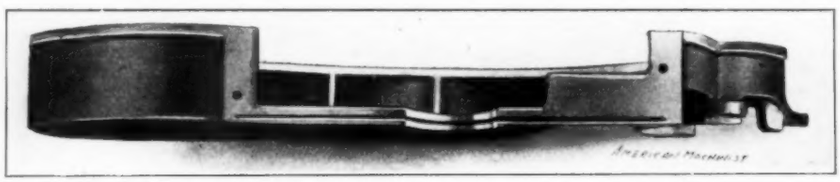
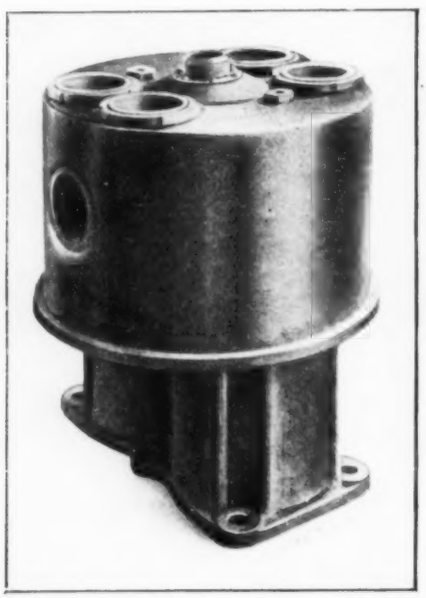
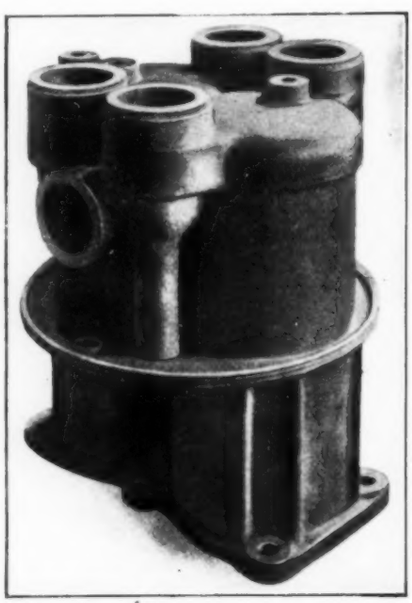


Fig. 3. Cam-gear Case Showing Packing Grooves





Figs. 1 and 2. Cylinder Casting in the Rough and with Copper Jacket Shrunk and Screwed in Place

It will be observed in Fig. 1 that there is a flange surrounding the cylinder casting about half way up. This acts as a seat for the copper jacket shown in Fig. 2. The jacket being heated is put on over the cylinder and contracts around this flange. The jacket itself would, of course, be too light to make an absolutely tight joint at this point and for that reason a ring of steel is turned and bored a shrink fit and shrunk on over the cop-

Fig. 4. Magneto Advance Parts and Milling Mandrel for Milling Spiral Ends of Pins

per, binding it firmly against the flange. Fig. 2 shows the steel ring in place. The joints around the openings at the top are taken care of by capstan nuts.

This concern gets all its crank shafts from Germany. The reason given was that the quality of the product was just as good as ours, the finish equal to the American and the deliveries better, while the price, duty paid, is about the same. The dimensions check up to within 0.00025 of the sizes ordered, the analysis and temper are very uniform, only about 1 per cent. proving defective in either of these particulars. Formerly a test piece was sent with, but separate from, each crank shaft. This did not prove satisfactory, so now the test piece is a part of each shaft and is cut off at the factory and analyzed and tested for strength and temper.

Fig. 3 shows one half of a cam gear case with a groove 1/8 inch wide by 5/16 inch deep. This job is done on a Whitney hand miller with their new vertical attachment, the job being handled in this machine in a very satisfactory manner. It will be understood that an end mill is used. The slot has a packing of felt driven into it to prevent the oil from working out of the case. The cam gears run immersed in oil.

Fig. 4 shows the parts of the magneto advance, together with the jig for milling the pins which slide in the spiral groove or slot in the sleeve. Finished and unfinished pins are shown in front in the cut and the arbor has several pins in place in it. The arbor is mounted on the spiral head and an end mill shapes the pins as desired. Fig. 5 shows an attachment, built by Brown & Sharpe to bolt to the table of one of their cylindrical grinders. It is for grinding the hardened cams after they have been keyed in place on the cam shaft. The pulley to the right operates through gears the master cams which in turn oscillate the part which carries the cam shaft. This makes a very satisfactory fixture.

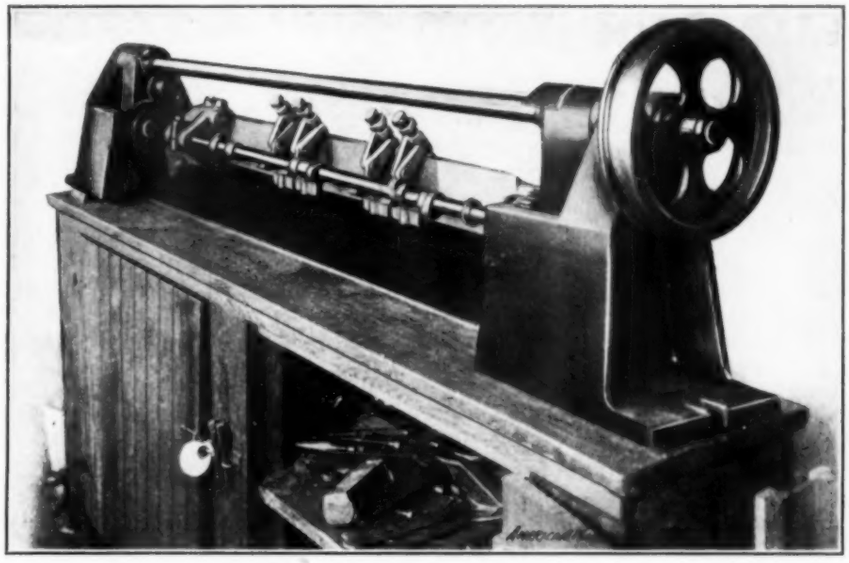


FIG. 5. ATTACHMENT FOR GRINDING HARDENED CAMS IN PLACE AFTER KEYING THEM TO THE SHAFT

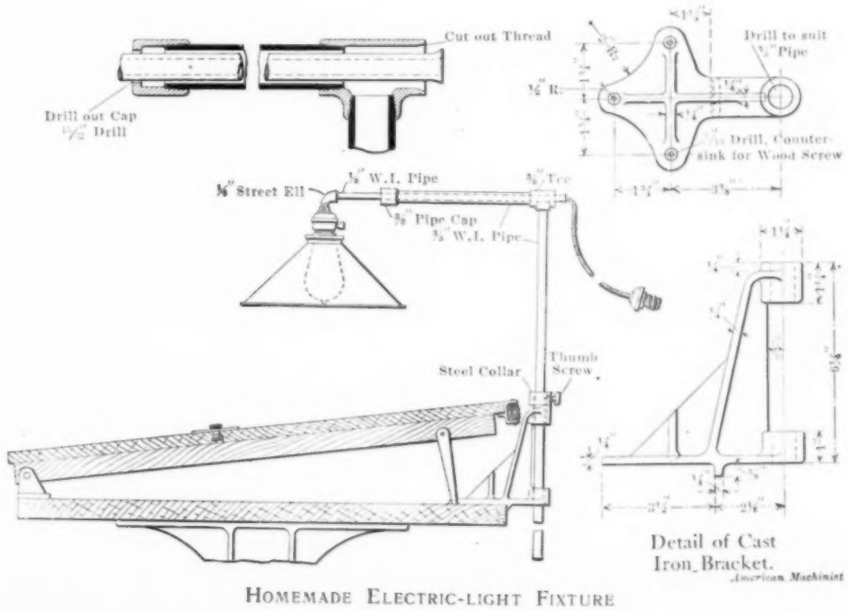
A Simple Electric Light Fixture for Board

By C. Pitts

An entirely satisfactory electric-light fixture for the drawing board is found only in a comparatively few drawing rooms. The one described here can no doubt be improved upon, but has given such good satisfaction that it might interest others. By referring to the accompanying sketches it will be noted that a light cast-iron bracket screwed to the drawing table carries the lamp standard and provides a bearing to allow the standard to swing to right or left. Over the vertical pipe is slipped a steel collar with thumb screw, which allows the standard to be raised or lowered. Adjustment in length of the horizontal arm is accomplished by one piece of pipe telescoping inside of the other.

On the lamp end of the horizontal arm, it will be noticed, there is a pipe cap drilled out to guide the small pipe containing the flexible cord. The end of the small pipe where cord enters, being "belled" out, also serves as a guide, protects the cord from chafing and acts as a stop, preventing the small pipe from being pulled out of place. The tee connecting the horizontal and vertical pipes, is also belled out on the open end to avoid the chafing of the cord at this point.

The sketches show the make up of the fixture. Being principally of wrought-iron pipe it is inexpensive, easy to make and more substantial than the ordinary fixture that can be purchased. By slight modification it can easily be adapted to numerous shop uses.



HOMEMADE ELECTRIC-LIGHT FIXTURE

The volume of work done in the shipyards of the United States in 1909 was not so large as in 1908, and it includes only two battle ships, as compared with three in the preceding year. Freighters, steamers, torpedo boat destroyers and submarines are among the returns for the year. It may be noticed as peculiar that varied though the work of the United States is there are very few motor vessels.

The Machining of Large Work by Unusual Methods

Special Tools and Devices Used on Large Gas Engines

Editorial Correspondence

Mechanics who are accustomed to small or ordinary-size work can hardly appreciate the problems that are involved in the building of large machinery where the pieces to be handled run up in the neighborhood of 100 tons each.

Some of the methods shown here, taken from the Snow Steam Pump Works, Buffalo, N. Y., are so different from ordinary shop practice as to be unusually interesting. As it was impossible to secure photographs, the accompanying sketches have been made to give an idea as to the methods employed. There has been no attempt to have these represent the actual tools or the work being done, the only thought being to show the principles involved, so that any mechanic could apply them in other cases.

Special Planing Jobs

One of the interesting jobs was a large gas-engine frame which is shown in the form of a box in Fig. 1, and which weighed in the neighborhood of 100 tons. The casting was located next to a floor plate and a large lathe head brought up to the end and the surface *S* swept off with a facing tool fixed in a slide on the face plate. Then the shaft *A A*, about 15 inches in diameter and having a substantial keyway on each side as indicated, was fastened in the bed by end plates *E E*, in a central position through the casting, and used as a basis for several of the planing operations.

As shown in Fig. 1, a substantial planer head *C*, here represented by a solid block, fits on the shaft *A* and is connected by the two bars *D D* with the table of a planer which has been moved and blocked up to the proper hight at the end of the casting. These bars *D D* fit the keyways of the shaft *A*, and are fastened to the head *C* so that they both guide and drive it according to the stroke of the planer.

As indicated here, a cross rail *D* has been bolted to the top of the head *C*, and the two tools *T T* plane off spots on the tops of the bed. The stroke can be regulated to the requirements by simply adjusting the stops on the planer table in the usual way, as the planing head *C* is simply an extension of the planer table, carrying two tools where they can be used. The bars *B B* are fastened substantially to the planer table, although no fastening is indicated. The other end of the planer table is held down by a substantial block of steel to prevent lifting, and the reversing lever is provided with the device shown in Fig. 2 to make the reversal positive, even under the most severe conditions. This is attached to the reversing lever, the weight sliding easily on the rod and insuring complete travel of the reversing belt.

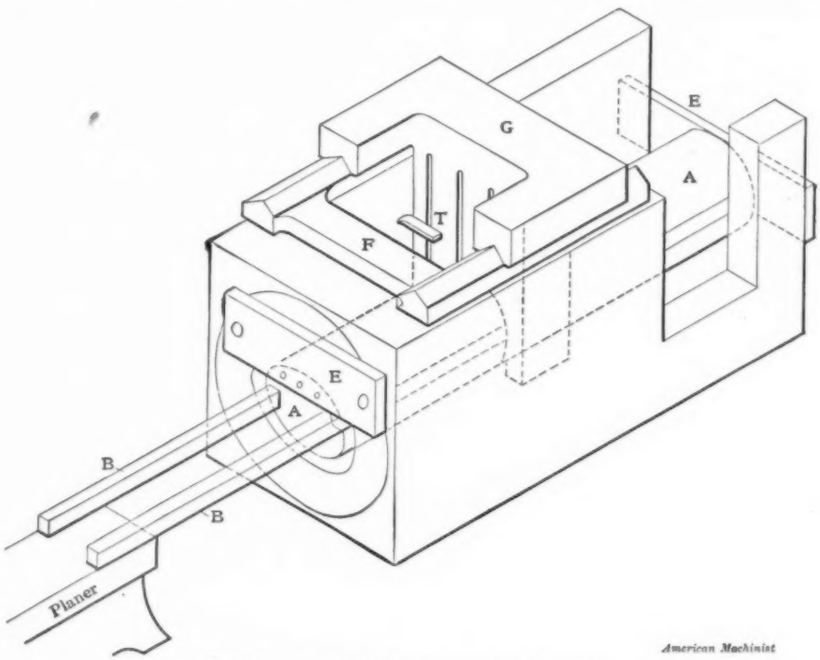


FIG. 3. GETTING DOWN ON THE INSIDE

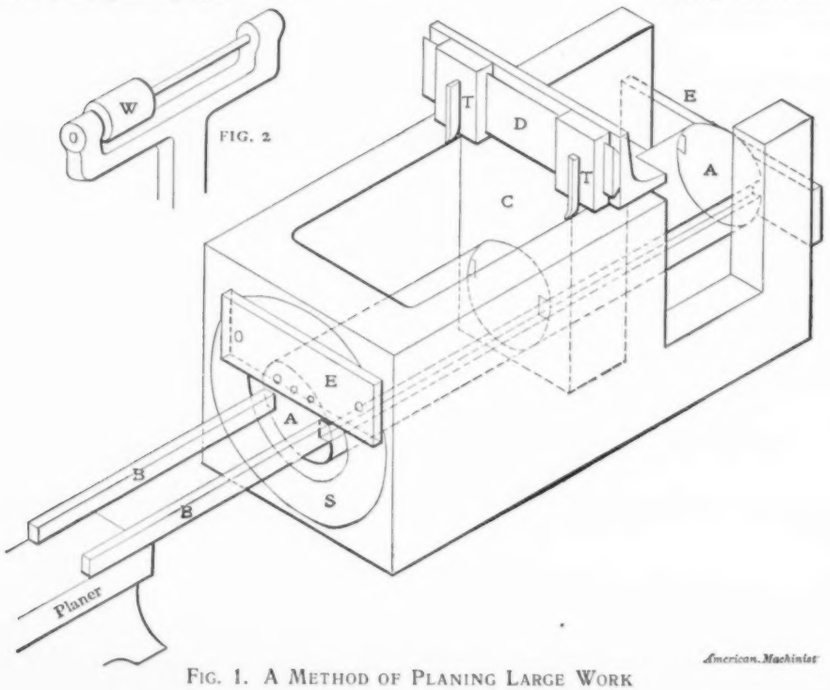


FIG. 1. A METHOD OF PLANING LARGE WORK

Planing on a False Bed

Fig. 3 shows another operation on this same casting. After the top has been planed off, the ways *F* are fastened in place and the planer head *G* fitted to the ways of *F* so as to guide it perfectly in its travel. The head *G* is driven in the same way as the other and carries tools on each side. Although only the

bare tools are shown, it will be understood that these are mounted in tool blocks and on slides in the regular way, and are fed by power either by star wheels or by a ratchet feed controlled by a rope.

Fig. 4 shows another planing operation at the other end of the bed in which the planing head *I* travels on a beam *H*, shown as a box section in this instance, but in reality being a heavy I-beam with a thick web. The tool head *I* is also provided with regulation slides and tool blocks so that all three sides of the pillow-block jaw can be readily planed. The planer which imparts motion to the tool head is necessarily blocked high in air as indicated, while the beam is supported by a substantial blocking at the outer end and by the shaft *A* at the inside. While these give rather meager details, the idea is clearly shown and can easily be adapted elsewhere.

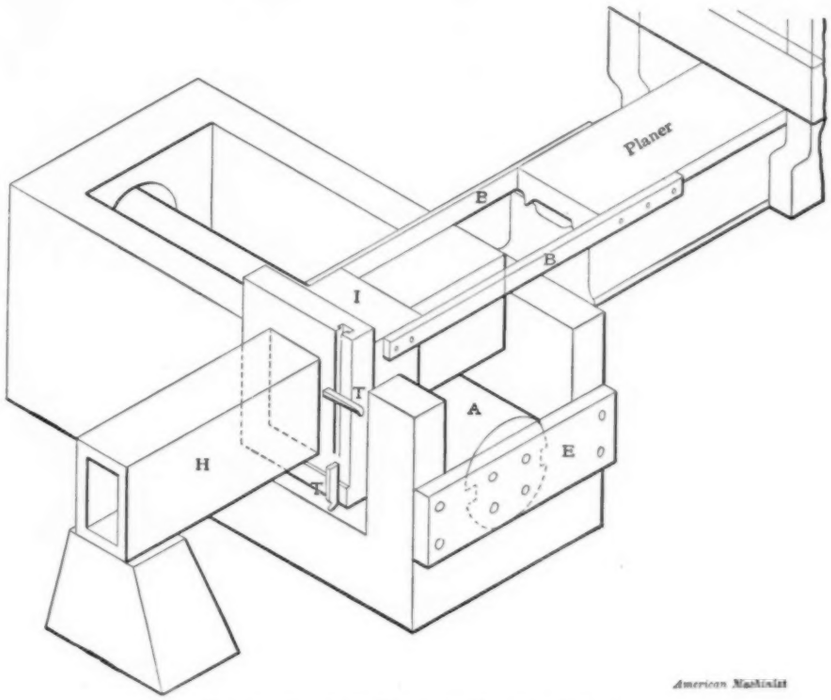


FIG. 4. PLANING OUT THE PILLOW BLOCK

ENLARGING A BORING MILL

Having a 10-foot boring mill and some 14-foot flywheels to turn, Mr. Bryan made what might be termed subbases for the boring-mill housing, as shown in Fig. 5. These are substantial castings of channel section and on the base there are three slides carrying tool blocks so that the rim of a flywheel can be turned and faced on both sides at the same time.

In addition to this, a boring head on the cross rail allows the hub to be bored at the same setting, so that it makes a very complete tool. The flywheel is shown in section so as to show all three tools at work.

FIXTURES FOR THE SLOTTER

The illustration in Fig. 6 shows a type of fixture used quite extensively on slotter work. It consists in this case of a triangular plate to hold the lever arm shown and locates it so as to insure duplicate work. A stud projecting from the center of the slotter table fits into a hole in the fixture so that the forging can be swung around this stud to allow the shaping of the outside being concentric with the hole, the radius being located by the adjustment of the slotter table. Surrounding these slotters is a circular track of steel rails to carry the supporting wheel shown. The work has a power feed which moves the work in the track as though it was part of the machine itself.

This fixture can be readily shifted to accommodate any desired parts of the lever, the hole *A* being the center for the radius, which will sweep the inside curve shown above it.

TURNING TRUNNIONS

A somewhat similar lever is shown in Fig. 7 mounted on a fixture in a horizontal boring machine, for turning the two trunnions on the outside so as to be in line with each other. The two bearings *A A* are bored out in line with each other and each carries a hollow milling tool or sweep as shown. The piece is located and held as can be readily seen, and the fixture swung so that one of the tools comes in line with the boring-machine spindle *B*, which drives it. This turns off the trunnion on that side by feeding the bar outward, and after this tool has been released from the spindle, the table is swung half way round and the other tool used in exactly the same way. In reality these are driven by universal joints to avoid the necessity for extreme care in alining with the spindles of the machine.

One of the largest angle plates I ever saw is illustrated in Fig. 8. This is adjustable to an angle of 45 degrees and this can of course be increased to any amount desired. In this particular case it was used for facing and drilling the holes in the pillow blocks of an engine bed which weighs several thousand pounds, the plates being in the neighborhood of 10 feet long and 5 feet wide.

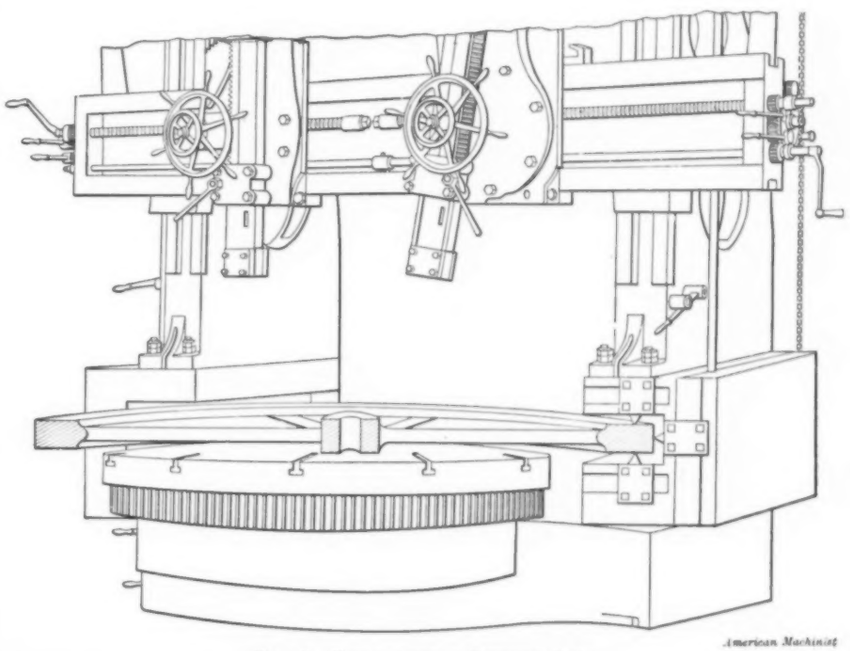


FIG. 5. ENLARGING A BORING MILL

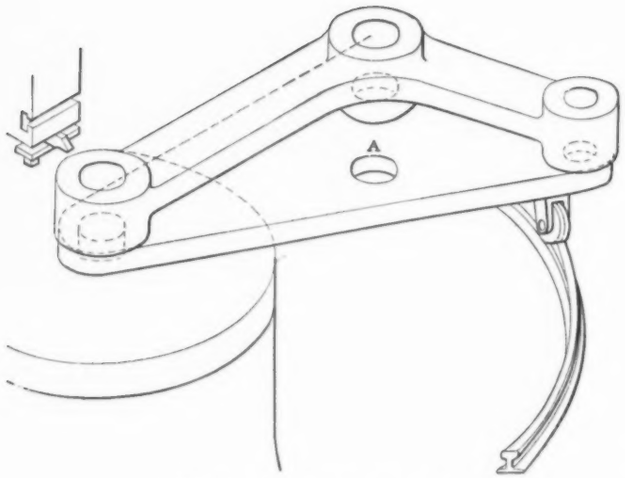


FIG. 6. A FIXTURE FOR THE SLOTTER

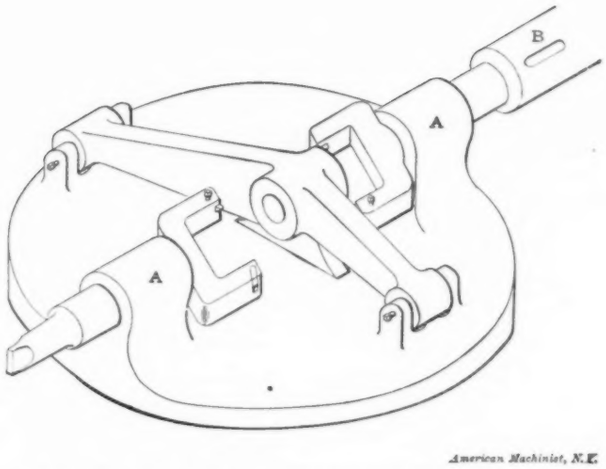


FIG. 7. TURNING TRUNNIONS ON A BORING MILL

TWO MILLING OPERATIONS

In the upper part of Fig. 9 are seen a few of the ports at the end of some blowing-engine cylinders. These are cut out from the solid by having holes drilled in the three corners and the holes milled out by the fixture shown below, used with a large radial drill. This fixture consists of an outer ring *C* carrying the inner piece *B*, which has a slide. The slide *A* is fed along the way shown and carries a milling spindle, which of course must travel in the direction of the slide. After milling from one hole to the next, the part *B* is turned the proper amount in the outer ring *C* and the next side is milled out. It can readily be seen how this method enables this work to be done quickly and accurately, the cylinder being turned from time to time so as to bring new portions under the action of the milling cutter.

Piston rings 6 and 7 feet in diameter are not easily handled, and the device shown in Fig. 10 gives an idea of the way in which they are cut up in this shop. A large vertical-spindle milling machine of the planer type carries a special fixture on the bed which carries the large plate shown at an angle of 45 degrees, the rings being placed on this plate, which is indexed from position to position as a cut is made. It is a very simple proposition, its chief interest being on account of its large size.

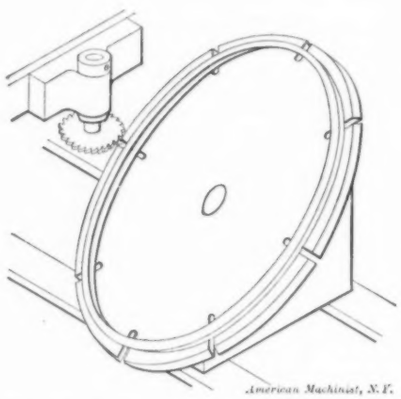


FIG. 10. CUTTING LARGE PISTON RINGS

TURNING A LARGE BALL JOINT

The exhaust pipes for the large gas engines are made with ball joints. These pipes are perhaps 15 inches in diameter and are clamped to the horizontal boring-machine table, while the tool shown in Fig. 11 is bolted to a flange on the spindle sleeve and driven by it. The curved portion *D* carries the correspondingly curved tool-holding bar *C* and guides it in a true arc, so that the tool turns a perfect ball joint. The tool bar *C* is slotted, as shown, and has gear teeth cut on the back side. A long pinion *D* meshes into this, while the rack *E*, which is fastened to the spindle and moves with it, passes through the slot in the tool bar *C* and also meshes with the pinion *D*. Any movement of the boring spindle moves the cutting tool with its bar, in an arc of a circle.

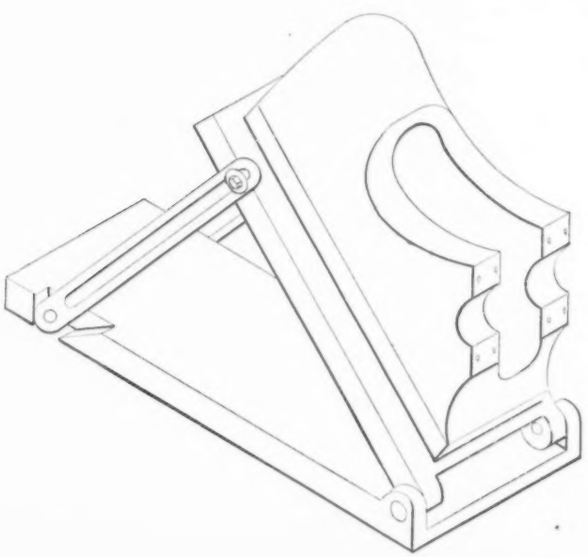


FIG. 8. A LARGE ADJUSTABLE ANGLE PLATE

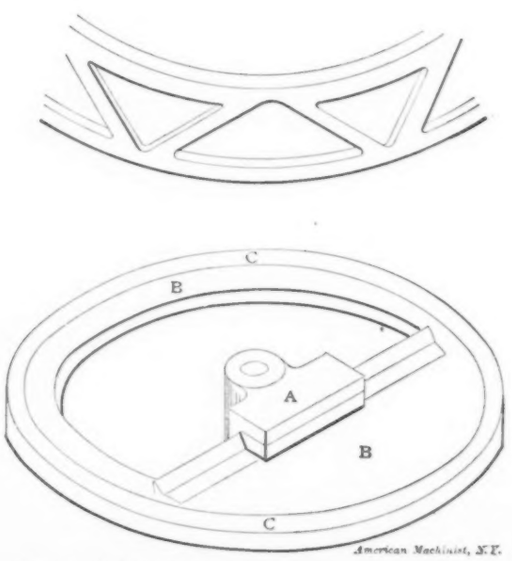


FIG. 9. A MILLING FIXTURE FOR ENGINE PORTS

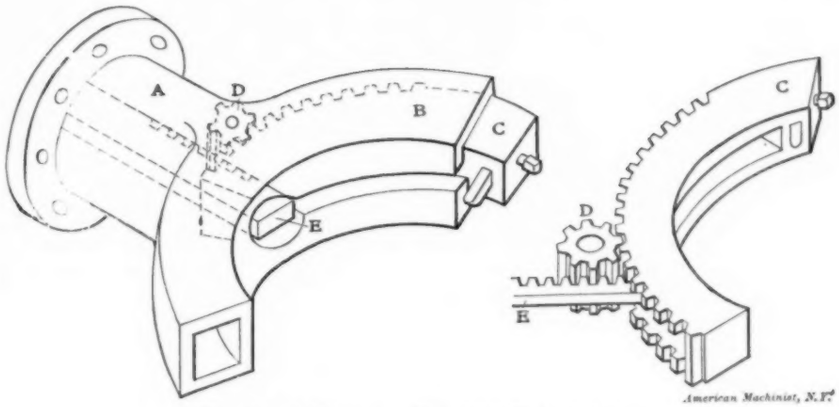


FIG. 11. A TOOL FOR TURNING BALL JOINTS

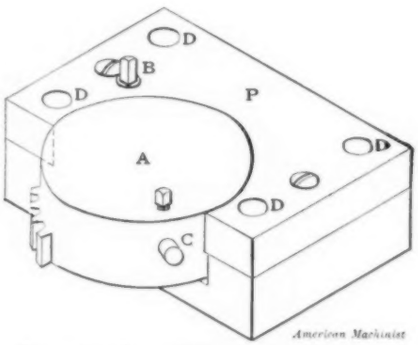


FIG. 12. TOOL BLOCK FOR TURNING FILLETS

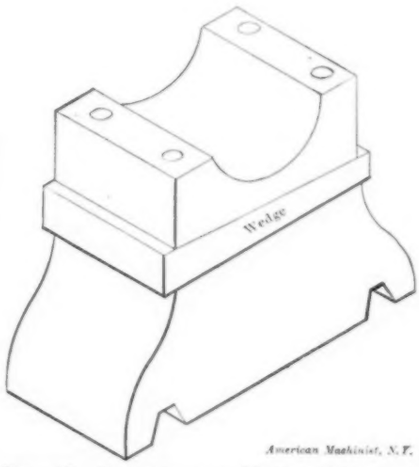


FIG. 13. SUPPORT FOR HEAVY SHAFTING

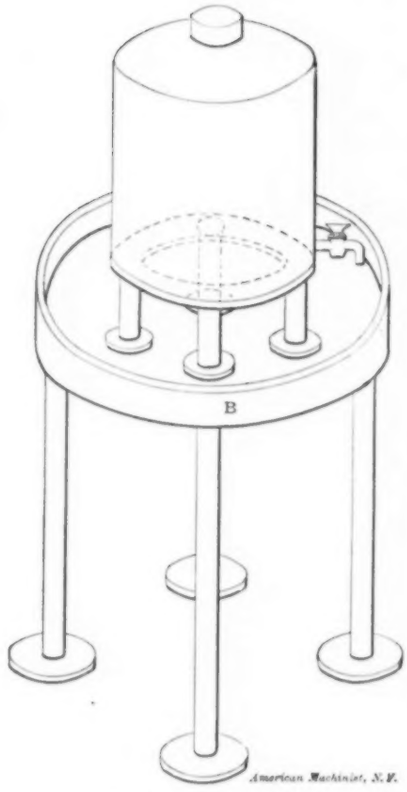


FIG. 18. STAND FOR OIL CAN

The large engine shafts weighing several tons have carefully turned fillets, and to secure these accurately and quickly the tool block shown in Fig. 12 has been devised. It consists of the disk *A*, having a partial gear cut on the lower half, so that the plate *T* holds it in place and allows it to be turned easily by a pinion on the lower end of *B*. The tool at *C* can be swung nearly 180 degrees, and the whole thing is fastened to the tool slide by four bolts through the holes *C*, *D*, making a very substantial arrangement.

In order to relieve the lathe centers from unnecessary strain these large shafts are supported at each end by the support shown in Fig. 13, which needs practically no explanation. The wedge allows careful adjustment, so that the load can be taken without disturbing its alinement on the lathe centers.

A NEAT DEEP HOLE JOB

These gas engines use a long piston rod, which acts in two cylinders and has an enlargement in the center. These are about 13 inches outside diameter and have a 9-inch hole bored so as to leave a wall in the center, as indicated in Fig. 16. This makes an interesting proposition, which is handled in this way.

A large core drill, consisting of about one-third of a tube of the proper diameter, as indicated in Fig. 17 at *T*, carries a cutting tool at the end and is firmly supported in a rest very close to the work. This is placed at the top so as to be easily cleared of chips.

The first operation is drilling and tapping the comparatively small hole shown at *A*, Fig. 14, and this is used to hold the end of the feed rod *F* by means of a threaded gland, not shown. This feed rod pulls the boring bar into the work, so that it is self-contained and relieves both the head and tail spindles of the lathe of all end thrust, a very desirable result and one that can be used to advantage in many places.

After the annular hole has been bored, leaving the core as shown in Fig. 16, the problem is to cut this off at the inner end. This is easily accomplished by the little device shown in Fig. 15, which is a tool

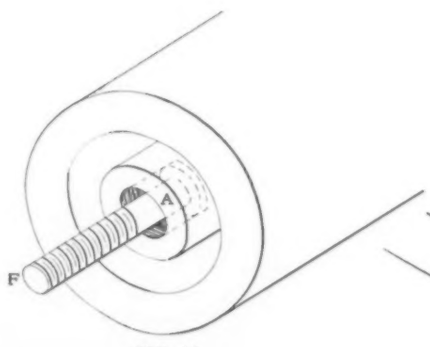


FIG. 14

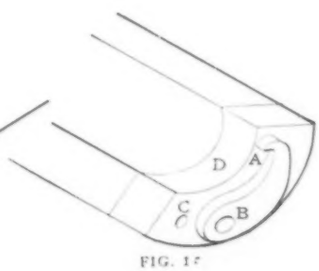


FIG. 15

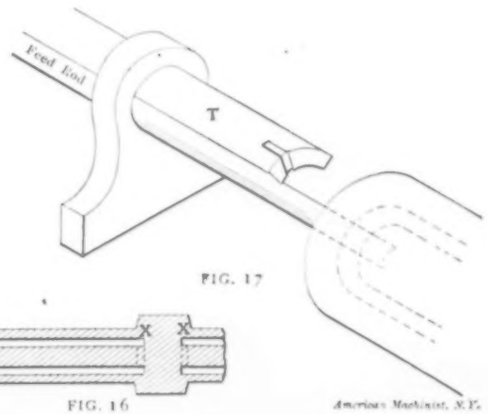


FIG. 17

FIG. 16

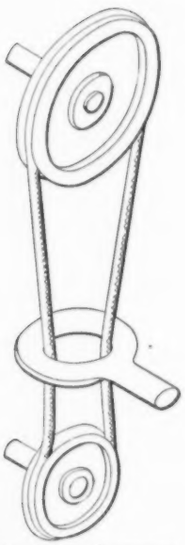


FIG. 19. BUFFING EYEBOLTS

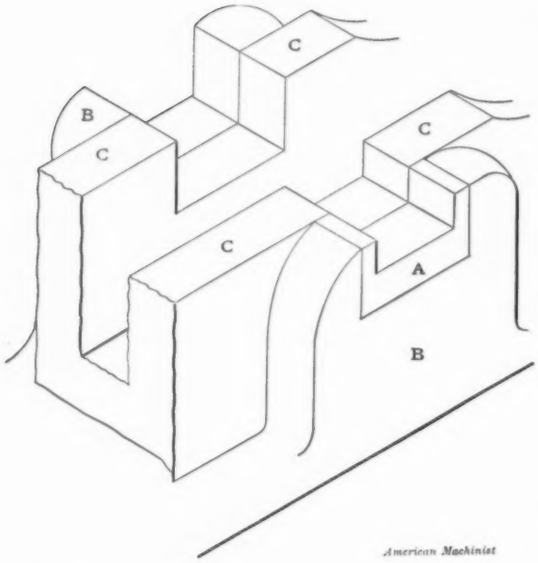


FIG. 20. FIXTURE FOR PLANING

block that fastens to the end of the boring bar and carries a cutting tool *A*, hinged at *B* and controlled through bevel and worm gearing (not shown) by a rod coming through *C*. It can be readily seen how when this has been pushed to the bottom of the hole, as *X*, Fig. 16, the cutting point *A* can be thrown down into contact with the inner end of the core

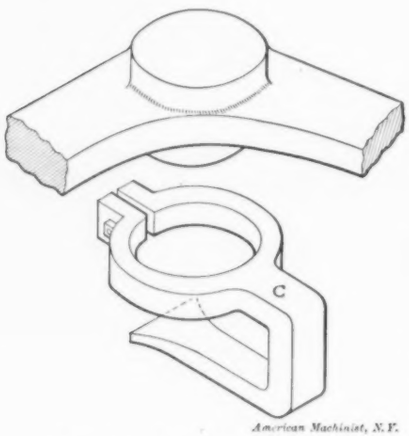


FIG. 21. CLAMP FOR LIFTING

and gradually cut it off until it is weakened sufficiently to break from its own weight. The cutting-off tool at Fig. 15 is shown upside down for the sake of clearness, but it can be readily understood that it operates on the end of boring bar *T* in the position shown in Fig. 17.

MINOR SHOP DETAILS

Fig. 18 shows a stand for oil cans, which is used quite extensively around the shop. This consists of a base *B*, which is practically a flanged boiler head of perhaps 24 inches in diameter, with a flange 3 inches deep. This is supported on four legs made of piping with flanges for feet; and inside the base, or bowl, is a smaller stand which holds a regular five-gallon oil can. This allows oil cans to be replaced with new ones at any time, and effectually prevents all dripping on the shop floor.

Fig. 19 shows a method of buffing eyebolts, which, although common practice in the making of scissors and hardware specialties, seems to be comparatively unknown in machine building. The buffing strap is put through the eye of the bolt, and then put around the lower wheel, which is adjustable for belt tension. Moving the work nearer the large wheel and also shifting it from side to side, accomplishes very good results in a comparatively short time.

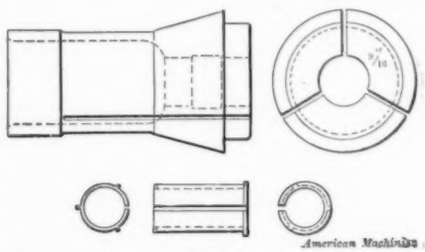
Fig. 20 is a suggestion for planing fixtures, which is capable of considerable modification and enlargement. The fixture *B* is made to do the work in hand, and its jaws planed out to the sizes desired on the casting to be machined. In this case the casting *C* has different sized openings on the two sides, the opening at the left being gaged by the jaw of the fixture itself, while that at the right is determined by the hardened block *A* set into the fixture until the tool has been properly set for this work. It is usually better to use hardened block in most cases if many pieces are to be planed, and this is simply intended as a sugestion along this line.

Another of the usual features here are what might be called lifting clamps or fixtures for heavy pieces. Fig. 21 shows a very simple device of this kind, in which the clamp *C* is made to fit over the hub of the lever shown above and to be clamped to it by the bolt shown. A projection underneath acts as a safeguard. Various modifications of this can be easily made; such as hinging the book underneath, so that it can be swung out of the way when the work is nearly down to the machine table, or can be locked in its safety position by a substantial pin.

Bushing for Screw Machine Collets

BY ALEXANDER BLIDEN

When using hard rubber or fiber in the screw machine it usually happens that the regular collets do not answer; they are either too small or too large, these materials being often 0.015 to 0.025 inch over their nominal sizes. Bushings in the collets become necessary, and it is quite a problem how to hold these securely. After several attempts with different constructions I have found the method here shown the best, the bushing being in one piece and self-holding. As the collets are recessed in the back and slotted in three or four places, it is only necessary to make a tool-steel tube with a shoulder at each end, the space between being a little more than the holding part of the chuck. Then one shoulder is filed away, leaving three or four



SCREW-MACHINE COLLET AND BUSHING

ears as shown, to correspond in location and size to the slots, and the bushing is split the whole length in one place. The size of the bushing hole in the collet in the drawing will accommodate stock considerably over 7/16 inch diameter, the collet used being a regular 9/16-inch, leaving the walls about 0.040 thick. Of course, when turning the bushing the outside diameter should be exactly that of the nominal size of the collet hole, and it is well to harden and temper to a blue. The hardening will open the tube sufficiently to allow the stock to be fed, with ease.

As in practice the collet is a little more open when out of the machine than when in place; it is easy to insert the bushing and a slight turn holds it, the placing of the collet in the machine closing the slots sufficiently to retain the bushing in place when in operation.

From a report made by the Interstate Commerce Commission it is noted that the fatalities in railroad operation in this country from 1888 to 1897 were 1 in 45,300,000 while from 1897 to the present time the fatalities were 1 in 54,900,000, a gain in ratio of over 20 per cent.

Automatic Machinery as Used in Office Work

Devices for Mailing Letters, Rate of Two Hundred a Minute

By R. S. Bayard

In most city offices of any size there is a large amount of daily mail matter which has to be sent out. As a rule these letters are first copied and after that comes the very laborious work of putting them into envelops, sealing the envelops and attaching stamps. The sealing and stamping operations are always troublesome and any machine which will do this work with accuracy as well as rapidity, is likely to receive a warm welcome in any large business office. Such a machine as this, which automatically seals and attaches stamps to envelops, is built by the Mailometer Company, of Detroit, Mich. The accompanying illustrations show its general appearance and also some of the details of the mechanism.

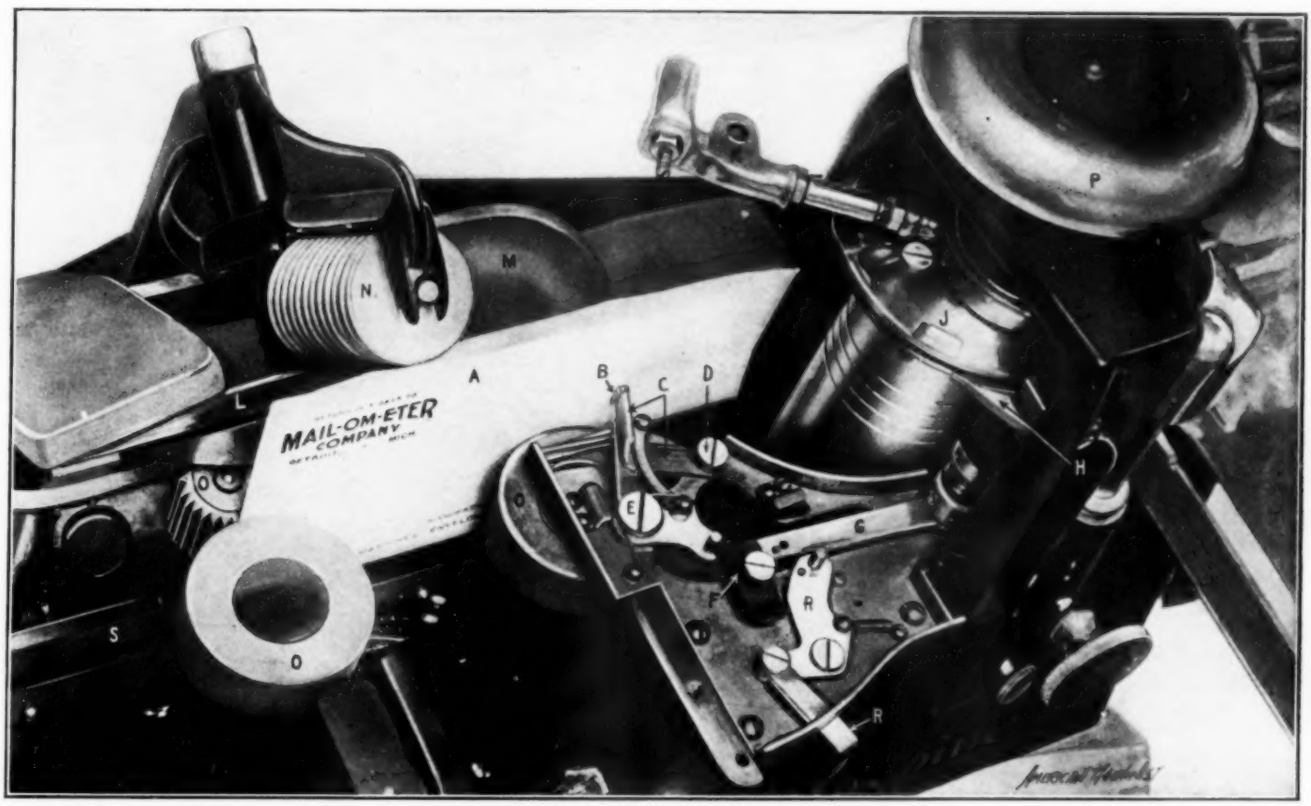


FIG. 1. VIEW OF TRIGGER MECHANISM. STAMP BOX REMOVED

A, envelop. *B*, roller at end of trigger. *C*, first section of first trigger. *D*, center for *C*. *E*, main center for first trigger. *F*, latch of second trigger *G*. *H*, clutch hook from *G*. *J*, top of clutch cylinder. *K K*, eccentric to feed stamps. *L*, moistening wheel for envelop flaps. *M*, water tank for *L*. *N*, weighted roller. *O*, feed rollers. *P*, flywheel. *R*, lock to disengage stamp feed. *S*, runway for envelops.

At the left end of the machine, upon the platform shown in the general view, a bunch of twenty or thirty letters is held by the operator against the rubber rim of a horizontally revolving wheel. Opposite this wheel and a little to the right, is a similar wheel which assists in the feeding of but a single letter at a time into the machinery. This is accomplished by making the two wheels rotate in opposite directions, the first wheel turning in such a direction as to feed the letters into the machine, while the other wheel turns in the other direction, so as to push back all but the first letter, which is pressed against the feeding wheel. In this way it is almost certain that only one letter at a time goes into the machine and these follow each other in very rapid succession, one behind the other.

As the letters pass along, a guide lifts up the envelop flap and passes it over the rim of a brass moistening wheel which dips down into a tank and by its revolution brings a thin film of water up to the top edge to moisten the glue upon the envelop. Beyond this moistener the flap is turned down and the letter passes between rolls, so located as to squeeze the air out of the envelop before the actual sealing takes place and to immediately follow this up by tightly pressing the glued edge of the flap down upon the envelop. This accomplishes the sealing, but perhaps the most important function of the machine is to attach the postage stamps.

ONE STAMP AT A TIME

In a nickel-plated metal case, having a plate-glass cover a reel of postage stamps is arranged, with the stamps attached to each other side by side in a ribbon. Thus the ribbon is as wide as the vertical hight of a single stamp. Each letter, in passing through the machine, strikes against a substantial, although exceedingly sensitive trigger. The pressure of the letter pushes this trigger to one side and this in turn operates a second trigger which throws in a clutch upon a vertical revolving shaft. The action of the trigger mechanism is such that as soon as the first one has moved, it allows the second trigger to fly back to its original position, so as to catch the clutch after it has

made a single revolution. The revolution of the clutch, which occurs once every time a letter strikes the first trigger, operates an eccentric which draws forward the ribbon of stamps a distance equal to the width of a single stamp. The drawing forward is accomplished by a group of pins, which pierce through the stamp, perforating it with the initials of the person mailing the letters, or with a conventional design.

It has been said that the feeding mechanism draws the stamp ribbon forward one stamp at a time. This statement is really very significant because it is a well known fact among those who have tried to design such a device, that as postage stamps are printed in ink on one side and have glue attached to the other side, they do not shrink evenly. Some of the stamps in certain portions of the sheet upon which they were originally printed, will be considerably different in size from stamps upon other parts of the same sheet. This difference, although hardly noticeable to the eye, is altogether too much to make it possible to automatically feed a single stamp at a time, merely by setting the steps of the feed equal to the standard width of a stamp. The result of such attempts is always to have irregularly cut stamps, very few of them being cut to correspond with the printing. This may, in a long ribbon, become so bad as to make the stamps useless.

Steel Feelers

In order to obviate this difficulty in cutting off postage stamps a very ingenious set of feeling fingers is provided, which after the ribbon has been drawn forward a distance slightly less than the width of one stamp, feel along the surface of the ribbon till they come to the perforations between the stamps. As soon as the fingers catch the perforations they push the ribbon up to the exact cutting-off position, corresponding with the printing. Stamps are perforated on a special machine by the government so that, even if the printing is unequal, the perforations correspond very closely with the printing. It is these feeling fingers which although they cannot detect the printing on a stamp do detect the perforations between the stamps, which make this machine possible. The feeling fingers are very delicate in their touch and are provided with fine points, which, together with the fact that they are placed closer together than the holes in the perforations of the stamps, makes it certain that at least one finger will find a perforation of the series and so adjust the stamp ribbon to exactly the right spot to be cut off.

The "Licker"

Cutting off of the stamp is the next operation and is accomplished by a pair of shears operated by cams, the cutting taking place exactly at the line of perforations. After being cut off, the stamp is passed between two rollers, one of which is a moistening roller. The moistening of the stamp has to be thoroughly and very carefully done, because if not sufficiently moist it will not stick and if too moist the water will be squeezed out upon the envelop and the appearance and probably the legibility of the address will be ruined. Water for the moistening is pumped by a rotary pump from a tank underneath. The water flows up to the top of a tube, where it overflows, runs down the outside, and being drawn by capillary attraction, most of the water goes over to the moistening roll. Enough water sticks to this roll, which is, of course, vertical, to thoroughly moisten the glue on the back of the stamp as it passes over it, while the superfluous water runs off at the bottom and down into the tank again. In order to be sure that no water shall be applied to the face of the stamp the guiding rollers are turned in narrow ridges so that they bear upon the stamp only in two places. At the worst the only water which could deface the stamp is in two very narrow lines which are dry before the stamp is thoroughly attached to the letter.

After being moistened the stamp passes out and is laid by a rubber roller perfectly flat upon the corner of the envelop, with its edges parallel to the edges of the latter. The letter then passes over to the right-hand side of the machine where it comes upon a horizontal table,

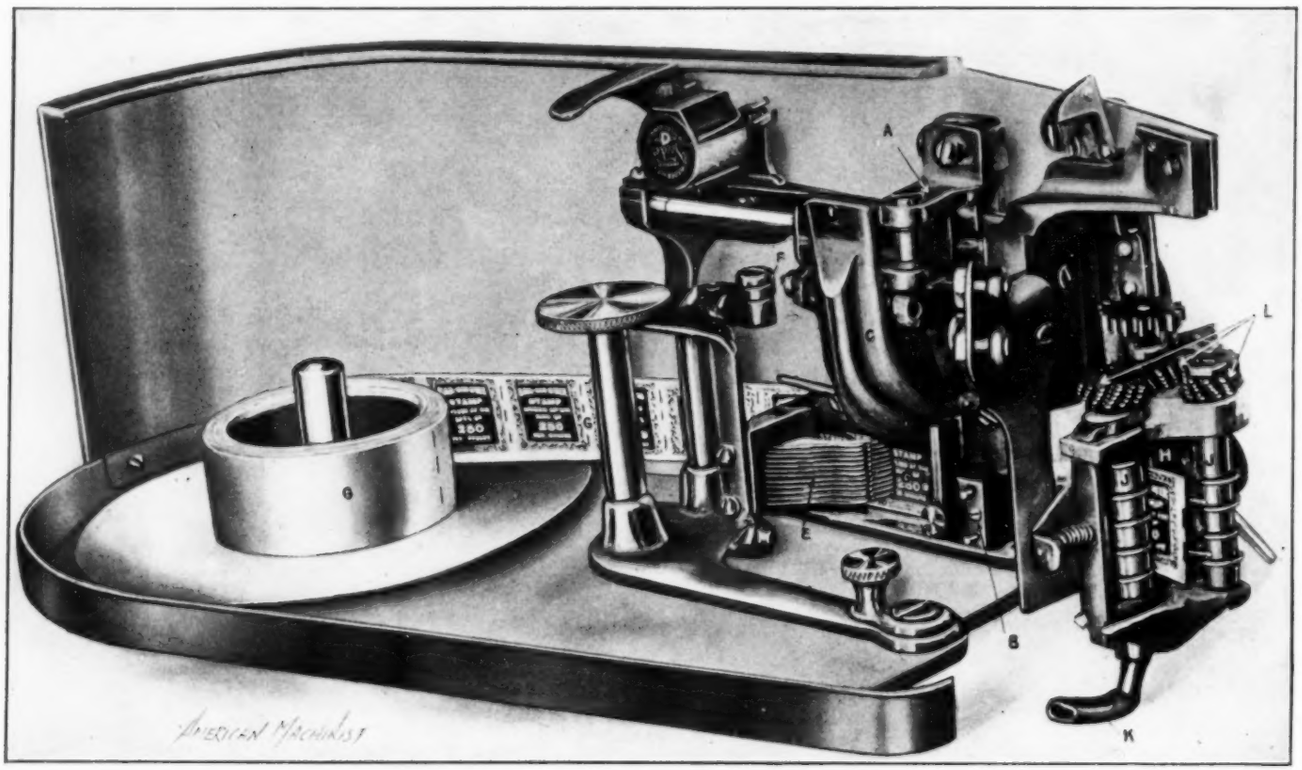


Fig. 3. View of Stamp Mechanism

A, crosshead moved by eccentric. *B*, clutch to draw and perforate stamps. *C*, arm for *B*. *D*, stamp counter. *E*, fingers which feel for perforations. *F*, operating arm of *E*. *G*, stamps. *H*, stamp moistening roll. *J*, stamp guide rolls. *K*, water pump connection to *H*. *L*, noiseless stepped gears.

the letters thus standing side by side on edge and held and guided by a weighted partition.

Problems Met with. The Delicate Touch

So much for the operation. Now for the difficulties overcome in the construction of the machine. In the first place it must be appreciated that a stamp mechanism operated by a trigger must be exceedingly sensitive, because a letter, particularly a single thickness, is not usually of very stiff material. The result is accomplished by using very light parts and delicate springs so that, with proper adjustment, it is actually possible to stamp a single sheet of letter paper passed through the machine. As the trigger is pushed aside by a letter, these following each other at intervals not greater than a half inch and as the letters pass through the machine at the rate of about two hundred a minute, it will certainly be appreciated that there is scarcely time between the passage of the letters for the trigger to fly back into its original position.

At the end of the little trigger is a very small roller, which as the trigger swings over, rides up on the face of the letter. A joint in the trigger then allows the latter to fly back into the right-angled position, although still pushed out of the track by the moving letter. The roller eliminates the friction between trigger and letter, so that the former can slide back. Just as soon as one letter has passed by, the trigger shoots out instantly, in a straight line at right angles to the path of the letter and so quick is this action that it does not fail to catch the next one as it comes along.

Employment of the trigger accomplishes two results. In the first place unless a letter is passing through and trips the trigger, no stamp is fed from the reel. Next, as the trigger is tripped by the front edge of the letter it is certain that the stamp is placed upon the envelop in the right position with reference to the corners, no matter what the length of the envelop.

The Human Fault

Moistening the stamp was also found to be a difficulty, not only from the mechanical standpoint, but also from the human standpoint. Machines were at first built which moistened the stamp from a small tank of water set above the apparatus. It was soon found that attendants often forgot to turn on the water; consequently the stamps were going through perfectly dry and were not being attached to the envelop. Such an action, of course, caused a great deal of annoyance, even though it was not the fault of the machine. To overcome this the tank was put underneath and the water supplied to the moistening roll by the pump. By this means no shut-off valve was necessary, because when the machine was not running the water was not being pumped and moreover no adjustment of the supply was necessary because all the excess water runs down off the roll and back into the tank again.

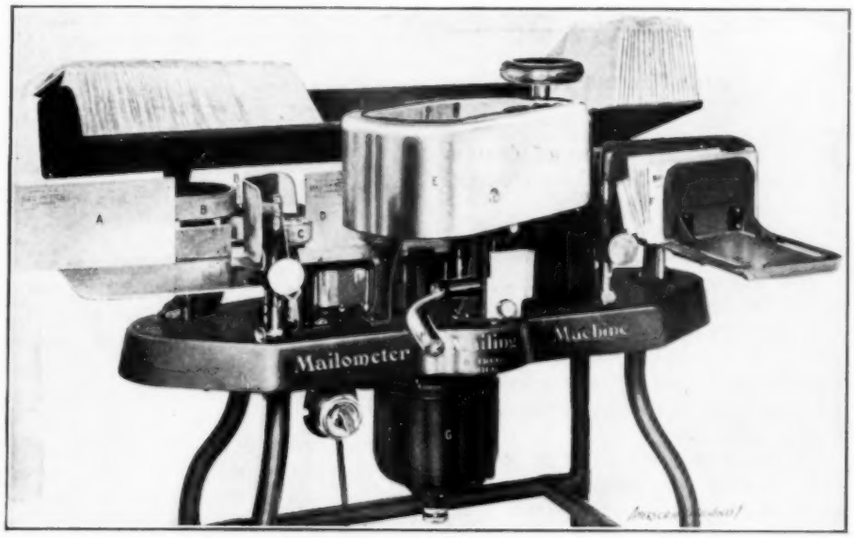


Fig. 2. General View of Machine

A, letter on feeding platform. *B*, feeding rolls. *C*, expelling roll to hold back all but one letter. *D*, letter being sealed. *E*, stamp mechanism box. *F*, sealed and stamped letters. *G*, driving motor. *H*, handle for adjustment.

Guarding the Stamps

Still another and probably one of the most important problems to be solved was to insure that the operator did not get away with the stamps. In the first place the stamp mechanism is inclosed in a locked box, the key to this box being in the hands of some responsible person in the office. This lock would, of course, prevent anyone from deliberately taking the stamps out of the box, but it will easily be seen that it would not prevent some one from running empty envelops through the machine and immediately taking the still damp stamps off the envelops for personal uses. Two precautions prevent this. First, inside the stamp box is a counting mechanism which counts each stamp as it is fed from the reel. Therefore, if the person in charge of the mailing department knows how many letters are mailed each day, he can, by observing the reading of the counter before and after sending out the mail, determine whether the number of stamps used corresponds with this.

Furthermore there is a second lock worked by a lever which when pulled throws the stamp-feeding mechanism out of operation. After once having been disconnected, it is not possible to again start the feeding of stamps until the stamp box itself is opened with the key which is in the hands of the person in charge of the mailing department. This person when going away from the office, can, by pulling this lever, make it impossible for anyone in any way to interfere with the stamps in the box until his return.

All Sizes in One

There is an adjustment by means of a single lever which makes it possible to take letters of any standard size through the same machine, always placing the stamps in the right spot. This is done simply by raising or lowering the runway through which the letters have to pass; the location of the stamp, as already shown, being assured by the actual length of the letters themselves and so being entirely automatic. Different thicknesses of letters are automatically provided for by the fact that the rollers are mounted upon springs.

Letters can be sent through these machines at the rate of 250 per minute although the average operator under continuous conditions will feed about 200 per minute. This can be kept up as long as the stamps last, when it is possible to replace the empty reel with a new one. Reels of stamps are furnished by the company that makes the machines, although it is understood that the Government will, in a short time, furnish stamps in reels. When desired the stamp mechanism may be shut off as described and thus the machine may be used as a sealing machine only.

A good method of making air-tight joints, according to the *Mechanical World*, is to mix white lead ground in oil with as much black oxide of manganese as possible; add a small quantity of litharge and knead the mass with the hands, dustnig the board with red lead. Make the mass into a small roll and place it on the plate, which has been oiled with linseed oil. It can then be screwed and pressed into position.

Letters *from* Practical Men Concerning *the* Details *of* Making things *in* Machine shops, *from the* First Sketch *to the* Sale

Practical Hints in Gear Cutting

The outside diameter of the gear blank should first be measured and any variations noted.

All burs should be removed from the ends of hubs which should be faced true with bore.

When putting several gears together on work arbor they must be faced unusually true or the arbor will be bent. This is especially true when the bore is small and the gears are large in diameter.

Be sure that work arbor has a proper fit in spindle of machine before tightening the draw bolt, also that it runs true before putting on the gear blank.

If a stock bushing does not fit the bore have one made. Do not use paper or tin; and don't use too many bushings.

Be sure that the proper side of rim goes against the back steady rest; this side should be chalked before the gear is taken out of the chuck when turning up the blank.

Use some judgment in tightening the nut on work arbor; that is, don't use or hammer on an 18-inch wrench for a one-inch arbor.

If outer support is used, be sure that it holds work arbor in a horizontal position. Special attention must be given to this point when mounting heavy gears, as they are very likely to draw down the outer end of arbor.

Throw out index worm and make sure that the gear runs true.

When setting steady rest be sure that there are no obstructions on the rim that will strike it and spoil the gear; also oil the surface of rim.

Put on proper feeds and speeds to suit the grade of material being cut and the type of cutter used.

Nick the gear around before starting the cut to prove the indexing.

Be sure that finishing cutter is central.

When dropping cutter for depth of tooth, allow for any error in outside diameter, that the tooth may be of the proper thickness at the pitch line.

Finish just enough of the end of one tooth to be sure of your thickness before proceeding further.

Use chordal tooth parts for measuring the teeth, do not depend upon the shake of the tooth gage.

If the pitch is not too coarse, two cutters may be employed; one for roughing and one to finish, the roughing cutter being separated from the finishing cutter by a spacing washer.

Care should be taken that the rougher cutter is not too large in diameter or too wide. If the teeth are first roughed out, the roughing cutter should be made to cut the full depth, leaving no stock for the finishing cutter at the bottom of tooth.

Roughing cutter should make central cut in tooth space, otherwise, one side of the finishing cutter will wear rapidly.

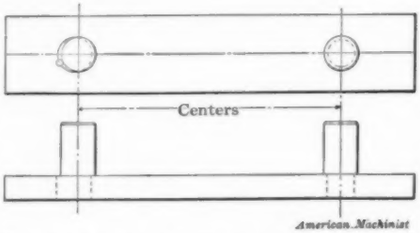


FIG. 1. A SIMPLE TESTING FIXTURE FOR GEARS

If the cutter shows signs of distress try cutting down the *speed* before changing the feed *per minute.*

Always use two cutters when possible. It has been argued that this makes inaccurate gears, owing to the change in temperature between the start and finish of the cutting; but such is not the case.

Do not remove gears from the machine until tooth thickness all around has been inspected; this, of course, is impractical for small work.

Use plenty of lubricant when cutting steel. If soda water does not seem to answer use oil; on the other hand, if oil does not give results, try soda water. When cutting bronze try cutting it dry if a lubricant does not give results, and *vice versa.*

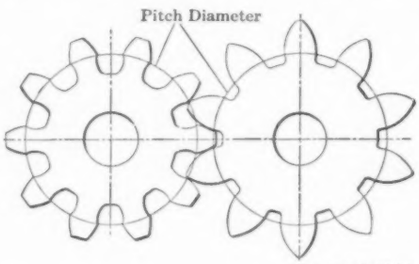


FIG. 2. ARRANGEMENT OF PITCH DIAMETERS TO POLISH TEETH BY SLIDING

Be sure that the cutting edges of finishing cutter are ground radial, otherwise an incorrectly shaped tooth will be the result.

Be sure that the key driving cutter does not bind on the top, otherwise the cutter will be broken. There are generally fillets in the corners of the cutter keyseat, therefore, the tops of key should be beveled off to suit.

Do not grind the cutter to suit the arbor; if the arbor runs out of true have it corrected—it will pay in the end.

It pays to use high-speed steel cutters, especially for the finer pitch (4 diametral pitch and under) but put up the speed to at least double that used for carbon cutters, keeping the speed per revolution of cutter the same.

Remember that it is not possible to operate a gear cut absolutely without backlash—there must be some allowance made. When it is known how the gears are to engage it is suggested that the pinions be cut standard; that is, no allowance be made, and that the teeth in engaging gear be made 0.01 of the circular pitch thin on the pitch line. On the other hand, when it is not definitely known how the gears engage cut all teeth 0.005 of the circular pitch thin. This would seem a better rule for general use. When generating bevel gears it is common practice to make the pinion tooth heavier than the gear tooth (according to the ratio) to give it additional life. Special provision is made on most of the bevel generating machines to make this setting.

When the number of gears to be cut justifies it, have pair of pins turned to fit the bore of the gears set in a plate at the proper center distance. This plate to be kept at the machine to test the work, as the cutter must be readjusted as it wears and changes in diameter. Exact centers may be cheaply attained in the gage by turning the stub of one of the pins entering plate eccentric, pinning it securely when adjusted to the proper centers. See Fig. 1.

After gears are cut there are always slight tool marks, burs, and minor inaccuracies, that will prevent the smoother operation when first assembled. If facilities are at hand to give the gears a running test, case-harden one gear out of the lot and run the balance of the gears with it for a short period in both directions. This will remove tool marks and insure the smooth operating of the gears and facilitate assembling of parts.

For spur gears it might be suggested that a gear for this purpose be cut on the Fellows shaper, Gleason planer or similar generating machine, enlarging the diameter of the gear until the pitch diameter is near the bottom of the tooth,

$$D = \frac{N + 4}{P}.$$

The teeth of a gear cut in this manner will have no rolling action, the pitch diameters not touching. The resulting sliding action is just what is required for the purpose mentioned—that is polishing the teeth. See Fig. 2.

New York. CHARLES H. LOGUE.

Adjustable Stops for Jigs and Fixtures

The AMERICAN MACHINIST has printed from time to time, descriptions and illustrations of various forms of adjustable stops, such as are used on profiling and milling fixtures, and also occasionally on drilling jigs. But most of these clamps, while perhaps very nice in theory, will fail when put to practical usage, especially when this usage is to be continuous and severe. Prominent among the contributory causes of their failure may be mentioned the following: Insufficient rigidity to prevent the backing away or loosening of the stop during the machining process; supersensitiveness, causing springing and distortion of the work in the fixture; clogging of the moving parts, due to the powdered metal gradually working its way into the various parts of the device; slowness of operation, due to the inaccessibility of the operating knobs, or to use of slow acting devices.

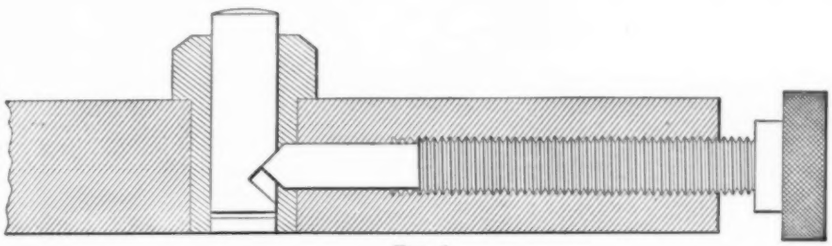


FIG. 1

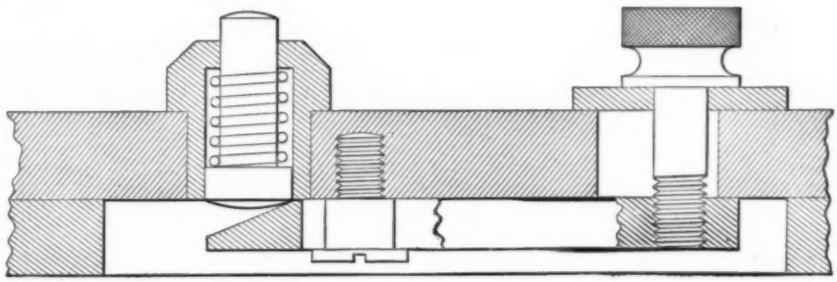


FIG. 2

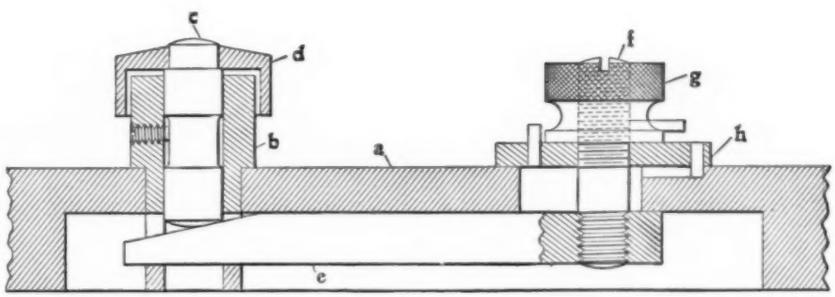


FIG. 3 *American Machinist*

TWO WRONG AND ONE CORRECT ADJUSTABLE STOPS

As comparative examples to illustrate these points, Fig. 1 shows a form of stop very frequently encountered consisting of a vertical tool-steel plunger sliding in a hardened-steel bushing and operated by means of a cone-pointed hardened-steel screw, provided with a nurled knob or butterfly head. This device, while apparently correct, has several bad features. In the first place, the power of a screw is usually underestimated by designers and also by the machine operators in the shop who have to use the device and here we have not only the powerful action of the screw, but also the wedge action of the conical end against the inclined surface of the plunger. Either of these would be quite sufficient to spring a medium-sized casting several thousands of an inch, with a very small application of power at the screw head.

As no two operators have the same degree of sensibility in their fingers, it will be seen that it is very unlikely that the same pressure will be brought upon the work in the fixture every time it is used. It follows that after the machine cut is made and the stop released, the work will spring back to its original shape and the result will be very inaccurate; furthermore, no protection is provided to exclude dust from the plunger and bushing and the powdered chips from the profiling and milling cutters find their way into the plunger bushing, rendering the device inoperative.

Fig. 2 shows another device, in which the vertical plunger has its motion imparted to it by means of a flat sliding wedge rod, the sliding wedge being operated by a nurled screw, through a slot in the fixture base and provided underneath its head with a dust washer to prevent the entrance of chips through the screw slot. It will be seen that this device is somewhat better than the one just described, as, there being no screw action on the wedge, it will be impossible to produce any great thrust upon the plunger. The nurled nut is loosened and used as a handle for pushing the wedge forward, causing the plunger to rise and firmly "contact" the surface of the work, after which the nurled screw is tightened, holding the wedge in position during the cut. It will be found, however, that with this stop the nurled nut, after being used for some time, will wear loose where it screws into the wedge, so that, when the wedge is pushed forward, the screw will take a tilt from the perpendicular, due to its loose fit and when it is tightened up at the end of its stroke it will settle back into a vertical position, leaving the wedge more or less loose under the plunger.

As a means of overcoming these defects, the stop shown in Fig. 3 was devised and continual usage has demonstrated its superiority. In the illustration *A* represents the fixture base, recessed on the under side with an end mill of sufficient size to allow proper clearance for the various parts. *B* is a hardened-steel bushing, driven through the base and fitted with a hardened-steel sliding plunger *C*. This plunger is shouldered at its upper end and has a dust cap *D* driven on it, forming a protecting apron to exclude chips. A small headless set screw, threaded through the bushing, serves to limit the travel of the plunger and prevent its falling out, at the same time permitting of easy removal when desired. *E* is a round, hardened-steel rod, cut at an angle of approximately 5 degrees on its left end and sliding through a round hole in the lower portion of the bushing *B*, so as to impart vertical motion to the plunger by its wedge action. A shouldered stud *F* is threaded and staked into the right-hand extremity of the wedge rod and is provided at its upper end with a nurled nut *G*, for clamping purposes. A dust plate *H* is provided under the clamping nut and may be either a round washer or an oval plate equipped with a small guide pin, as

shown, which serves to keep the plate in its proper alinement, by sliding in a slot in the base *A*. A short pin is driven into the nurled nut and a similar pin is driven into the dust plate *H* in such a position that when the nut is turned sufficiently to release the clamp, the two pins will meet. This prevents the operator making any unnecessary movements in operating the clamp, as it can be released or tightened by a half turn of the knob. Yet, if these stop pins were not provided some operators would feel it necessary to give the nurled nut two or three turns, which would allow the dust plate to lift and permit the entrance of chips to the working parts.

On account of the stud *F* being permanently screwed to the wedge rod *E*, it will be noticed that there is no tilt action, such as would be encountered in the construction shown in Fig. 2.

Modifications of this stop are readily made to adapt it to the various classes of work encountered.

Dayton, Ohio. B. F. CLARK.

Fixture for Milling Cam Slots

The sketch shows a fixture for milling two slots in opposite sides of a sleeve which was used as a lifting cam. It was cut on an ordinary milling machine with an indexing fixture such as is used for square or hexagon work.

In this case the stud on which the worm wheel revolves was taken out and a new one fitted and fixed to the base. On top of the worm wheel was fixed a collar *A*, with a flange which was cut and used as a cam to lift the former *B*, which was provided with a slot of the exact form to be cut in the sleeve. The former *B* was guided by a cross-pin in the center stud which fitted the slot in *B* so that when it was raised by turning cam *A* the pin caused *B* to turn on the stud, and as it followed the guide slot the correct form of slot was produced in the sleeve.

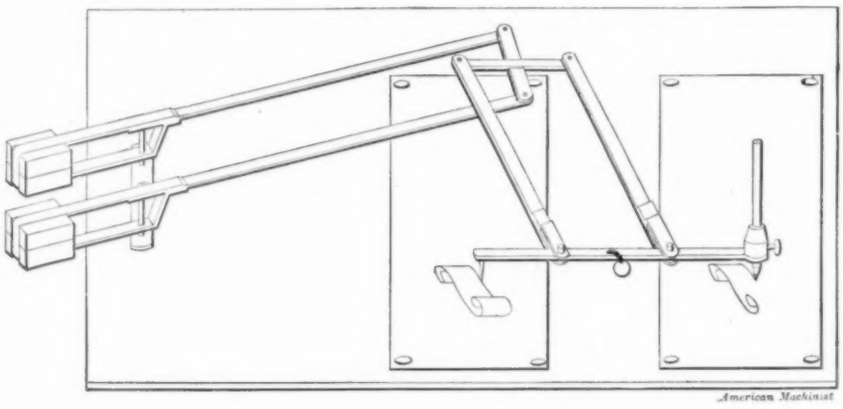
There were two holes in the sleeve *C* and a hole in the former *B* through which a pin was pushed for locating and driving the work. After the first slot was cut the pin was taken out, the other hole brought in position, the pin pushed in and the second slot cut. In this case the index plate was locked and only the worm wheel was rotated. An ordinary end mill was used of the same diameter as the width of the slot.

In operation the former was set so that it rested on the lowest point of the cam and the cutter set central with the stud. A sleeve was put on the former and the pin inserted in one of the holes. The table was then fed in against a stop so that the end mill just passed through the sleeve. Prior to this a larger end mill was put in and the former cut away along the slot so that it would clear the end mill to be used on the job. The former *B* was long enough so that the cutter cleared the sleeve when the former was on the lowest part of the cam. As the worm wheel was revolved it lifted the former, and as it was controlled by the cross-pin in the guide slot a similar slot was cut in the sleeve. When the mill came to the end of the slot the table was fed out and the former *B* brought again to the lowest part of the cam. The work *C* was then turned half way around, the pin inserted in the other hole and the second slot cut in the same way. As the holes were drilled in correct position the slots came opposite each other.

London, England. C. PETITJEAN.

A Drawing Duplicator

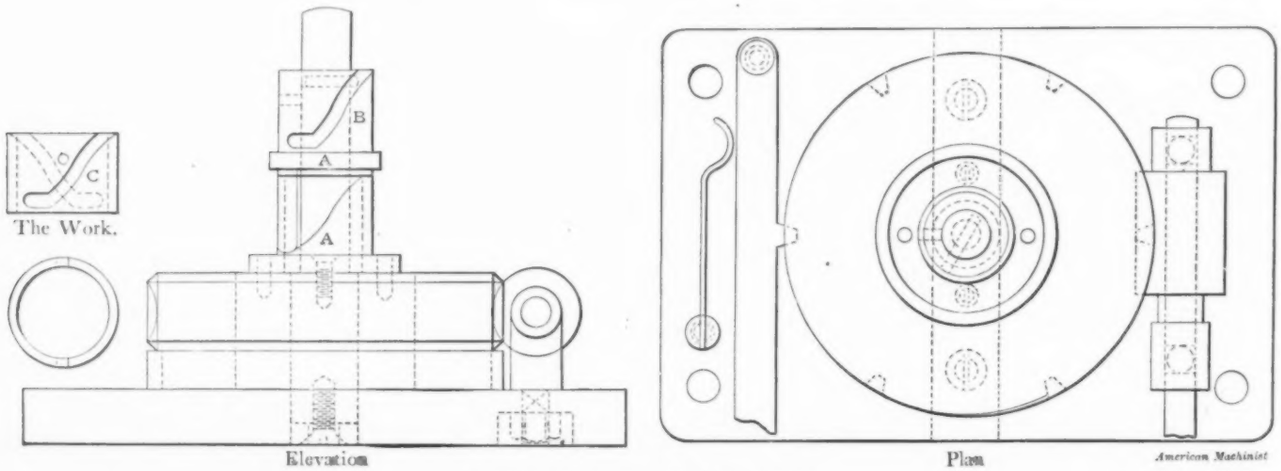
Am sending a sketch of an instrument I made for obtaining outlines in copying pictures. I have several pantographs for enlarging, but needed one that would duplicate.



A DRAWING DUPLICATING INSTRUMENT

The drawing is not to scale, but is about half size. None of the joints are fastened and it can be arranged for right or left-hand work. It is operated with thumb and finger on ball in middle of bar. Made of brass ¼ x ⅛ inch.

Birmingham, Ala. W. B. ODELL.



FIXTURE FOR MILLING CAM SLOTS

Discussion *of the* Previous Question

Letters from Our Readers Showing how many Men of many Minds Look upon Various Subjects Opened up in previous Numbers

Multiple Housings for Large Planers

On page 1143, Volume 32, Part 2, A. A. B., criticizes my scheme of fixing multiple standards to planers, in rather a captious manner, but "he comes round at the finish" and says, "The principle advanced is, I think, very good." As it is *the principle* I stand by, and its application to planing table tops of saw-benches is secondary, he will grant me a "win."

There are some jobs done in a machine shop which each and every man is equally equipped for carrying through; while there are other jobs in which one or two men have specialized, and can beat the rest two-to-one. I have specialized in planing and incidentally in planing table tops of saw-benches and will endeavor to assist my American relative to understand the method of doing these, at the same time disproving his assertion of lack of driving power required for a multiple housing machine.

As to power required to finish off six table-tops at once, does not A. A. B. know that a planing machine having a 30-foot table and other dimensions in proportion is easily capable of taking four 1-inch cuts (four tool boxes) at a feed of 12 to the inch, steel bloom? If a machine is capable of doing this, surely it possesses enough power to take a finishing cut over table tops six at a time. Is not that so?

The next point in which A. A. B. has fallen into error, may to a certain extent be palliated. I mean his reference to "planing on stilts." Now, the phrase does in no way apply and though it is rather beside the purpose of the article in which I advocate a system, I want him to understand that the saw benches referred to are not "stilty" or "spidery" but sound, substantial structures. He will understand this if he grasps the proportions given in my article: Length, 8 feet; width, 4 feet; hight, 2 feet 4 inches. Besides, the castings which form the sides of the framing are in one piece for each particular side and designed in such a way, of spandrel form, as to give stability while sawing. This form lends itself to the multiple planing project. I hope that is clear to A. A. B., of Poughkeepsie, N. Y. I did not intend to enlarge on the subject of saw-bench building, but as my friend has criticized my method, I in courtesy must answer him.

There are shops where it takes days to get a saw-bench structure together, i.e., planed for standards and table drilled, tapped, screwed and bolted. In the shop to which I referred we could divide the time by four and not kill ourselves.

The standards were planed on a side planer (Richards, of Manchester, England). The tables were nipped on the edges by false dogs, and the under side planed for the standard facings, six at a time. They were turned over and again nipped at the sides with screw dogs; a rough cut of from ¼ inch to ⅜ inch taken over the table top at a 12-inch feed—six at a time. The gap was then planed in each table, two at a time.

They were taken off the machine, others were put on, while the gap pieces (which had been planed on their edges and rough planed on their faces, on a small machine) were fitted. This, having been done, they, in their turn were fixed to their standards and were ready to be fixed on the multiple planer for taking a finishing cut over the top and gap piece as well. The finishing cut was taken at a ¼-inch feed and the six tops were planed in from 3½ to 4 hours. It would take that time to do ten tables with a machine, minus multiple housings.

That is the way to build saw benches; by which explanation I expect others here and in the States to profit.

London, England. J. T. TOWLSON.

Financial Mechanics of Aviation

"High flying mathematics" are probably appropriate and necessary for the calculation of aëroplanes, helicopters, ornithopters, ornithoplanes and their kindred, and no doubt the methods of calculation for these devices are different from ordinary "land" mathematics. On page 301 M. C. Krarup has an article under the heading given above, in which some remarkable mathematical methods are introduced. If Mr. Krarup's methods of calculation are correct, some very startling discoveries in domestic economy are immediately in order.

What is referred to, is the method of calculating the power required to cause a flying machine to "hover" over one spot. The statement is made in the article that a body falling under the influence of gravity will move 16 feet in the first second, and the work done in resisting this might be figured by multiplying the weight sustained by the speed of 16 feet per second.

To apply this method of calculation to domestic affairs of a very homely nature, consider the simple case of an overcoat hanging on a rack. Now my zero overcoat weighs about ten pounds, although it has no fur collar. If this coat when hanging on the rack, should suddenly break loose and fall off and could drop through the floor without striking, it would fall about 16 feet in the first second; that is, not counting air resistance. Now according to Mr. Krarup's method of calculation the power required to hold that coat up is its weight multiplied by its speed of falling, and this would then amount to 160 foot pounds in the first second. At this rate, this would amount to 9,600 foot pounds per minute. In plain English this means that the hat-rack is doing 9,600 foot pounds of work every minute that it prevents my coat from falling on the floor. Dividing by 33,000 this makes 0.291 horsepower!

To compare this with a steam engine consuming four pounds of coal per horsepower hour, this hat-rack would require 1.164 pounds of coal per hour, to hold my coat. Counting on six months, or 180 days of winter, and the fact that my coat spends an average of about ten hours per night hanging on the rack, or 1800 hours per winter, and multiplying this by 1.164 we have 2095 pounds, or a little over one ton of coal burned per winter to hold my coat on the rack. I was always well aware of the fact that it took more coal to run the house during the winter than it did in summer, but heretofore I have laid this to the fact that the furnace was running in winter. I realize now that considerable of this coal should be charged up against the hat-rack.

By a similar process of reasoning, and by taking the proper horizontal component of the force, it would not be difficult to calculate the horsepower exerted by the lamp-post on the corner, when supporting a 225-pound policeman leaning against it at an angle of 82½ degrees.

Now to secure a reasonable method of figuring what Mr. Krarup is aiming at, why would it not be logical to assume what actually happens; that is, that the revolving propeller blades of the helicopter are pulling down a continuous stream of air, while the machine itself remains stationary above the earth? The resistance opposed by the air parallel to the line of motion, would be the weight of the machine, or as he has it, 1200 pounds and this multiplied by the vertical distance through which the current of air

would be forced to travel by the propeller in one minute, in feet, would be the foot pounds of work per minute theoretically required to hold up the flying machine.

To apply this to an aëroplane; supposing it to be flying on a dead horizontal line, why would it not be reasonable to assume that the air is drawn down through a vertical distance calculated from the horizontal distance and the known angle of its planes? In other words, the vertical distance would be the horizontal distance traversed in a given time, multiplied by the tangent of the angle of the planes. The force, or resistance, would again be the weight of the machine, and the product of this force by the distance through which the air is forced downward should give the theoretical horsepower.

No doubt, in both these cases this horsepower would figure out very much less than that actually required to perform these operations, and it is just in that point that our methods of applying power to the process of flying are uneconomical.

New York City. R. S. BAYARD.

Ball Bearings and Methods of Testing

It is a pleasure and an education to read the splendid contribution on the above subject by Henry Hess, on page 1122, Volume 32, Part 2. It is a valuable asset to us, who dabble in ball-bearing problems and who sometimes fall into gross error from want of knowledge of the subject. His statement, "Actual use demonstrated anew an old engineering experience as to the fallacy of reasoning that constructions suitable for light loads were necessarily applicable to heavier ones by a mere increase of dimension," was a short time ago verified by a unique experience. An error of judgment landed me in serious trouble which I desire others to avoid.

A large press, such as is used in potteries for making sewer pipes 4 feet diameter by 4 feet in length, constantly gave out at the phosphor-bronze thrust collar. This collar was of 8-inch bore, having a single thrust flange 12 inches diameter. I sought to improve matters by introducing a single-row ball-thrust bearing of ample proportions. The design and cost were submitted, but no account of the high cost of the large ball races—which it was proposed to make in steel—the price of the change was considered prohibitive.

A substitution of good cast iron with increased dimensions was submitted to my judgment. I agreed to put it to trial. There were twenty-two 1¼-inch balls, of fine quality, from approved makers; both races were made and properly fitted in the usual way and applied to the thrust of the press.

I never expected that we should get good and lasting results from the cast-iron races though I hoped the ample proportions would make up somewhat for what was lacking in the material. However, the way and the time in which those races were cut up was a surprise, and a lesson to me. We started to run the press at 6 o'clock one morning, and at 8:30 the same morning the races were a complete wreck.

Three-quarters of an inch had been left between the outside edges of the top and bottom races but after running 2½ hours, both edges were touching; the balls having crushed (or abraded) the cast-iron races to a depth of ⅜ inch. One could hardly find the balls for cast-iron powder.

Needless to say, the press was dismantled, the "improvement" taken away, and the original plan of a plain thrust collar was resorted to.

London, England. J. T. TOWLSON.

Semi-automatic Metal Trimming Lathe

On page 161 is an article by W. W. Patterson regarding a sheet-metal trimming lathe. I have looked this over very carefully and noted the movements as described and would offer some kindly criticism regarding the design, as I have designed several machines for this purpose, all of which are in successful operation today.

First; there should be a thrust bearing of some sort for the spindle *N*, as it is at present most of the wear from the thrust due to holding the shell in position would come at the bearing *B* and gear *V*, this being especially poor as the description states that the gear *V* is free on the spindle *N*. Thus, the thrust would tend to clamp the gear against the bearing, creating excessive friction.

Second; the follower *J* in the rod *H* should be so arranged that it would relieve itself in case there should be a variation in thickness of the bottom of the shell or, if some scrap should perchance be there, the machine would be strained. This would cause the collar *R* to slip and require readjustment. As a remedy I would suggest a spring follower at *J*.

Third; the arrangement used at *R* for taking motion from the cam *F*, might be greatly improved, as the only thing which keeps the rod *H* from turning on account of cam action, is the keyway in the bearing next to *d*. As this rod *H* must have two movements for every shell, the wear on the keyway would soon cause a cramping action at the collar *R*, in connection with the cam *F*.

Fourth; as the follower *J* and the shedder or stripper *I*, are actuated by the same cam and have the same motion, considerable time is lost by this arrangement. Mr. Patterson has not explained how he gets his shell from the shuttle to the arbor *G*. He states that the shuttle is fastened to a gear segment which in turn has no lateral movement and that the follower *J* pushes it from the shuttle to the arbor. I would be pleased to know just how this was accomplished in this case and how the shell was supported between the shuttle and arbor. Also what provision was made regarding the shell being stripped so that this would not interfere with the shuttle arrangement.

Regarding the capacity of the machine; for a semi-automatic, from 40,000 to 60,000 shells per day is extraordinary as this would represent, at the lower figure, an average output of over 65 shells per minute for every minute in a day of 10 hours.

Waterbury, Conn. "MODERN."

A Precision Slide Rule

With reference to the description of "A Precision Slide Rule" given on page 1034, Volume 32, Part 2, AMERICAN MACHINIST, I would say that about two years and a half ago, I suggested the use of a "saw-tooth" scale for slide rules, with division lines on the cursor glass, just as described, except that I applied the principle to *each* of the spaces which now appear on the 10-inch rule, and not to the main spaces only as does Mr. Lurie, and which is of course, less accurate. Mr. Lurie will find it an improvement to omit *all the vertical lines*. They are not essential and certainly confuse the eye. They are omitted in the diagonal scale to be found on the old rectangular protractor, which, by the way, affords a good example of the application of the principle now under discussion.

I should add that in view of the very great difficulty of engraving such a slide-rule scale, together with the eye strain involved in reading it, I came to the conclusion that the idea was an impracticable one.

C. N. PICKWORTH.

Fallowfield, Manchester, Eng.

In a paper presented to the Engineers' Society of Western Pennsylvania, on February 15, by J. C. Roberts, assistant chief engineer of the Technologic Branch of the United States Geological Survey, on the Government testing station in Pittsburg, it was pointed out that the work of the station up to the present time, with structural materials has been confined to reinforced concrete and the constituent material of concrete and to the testing of various clay products in the Clay Products Bureau. During 1910 it is expected that a 10,000,000-pound testing machine will be installed, capable of testing 65 feet full-size section columns, etc. When this mammoth machine is put into operation and tests made upon it some extremely interesting results are expected.

Engineers' Meeting in Boston

Editorial Correspondence

A well attended meeting of the engineers of Boston and vicinity was held on the evening of Wednesday, February 16, in the Assembly Room of the Boston City Club. Some time before the meeting was called to order the room was well filled and later on a notice "Standing room only" would have been appropriate.

The meeting was conducted by the American Institute of Electrical Engineers, with the coöperation of the American Society of Mechanical Engineers. Five papers were read, followed by a number of discussions. The first three papers presented from several viewpoints the question of supplying power for shops from central stations. These papers were by Dugal C. Jackson, Charles T. Main and R. S. Hale, respectively. Mr. Main was absent.

Mr. Jackson summed up the greatest advantage of the electrical distribution of power over mechanical transmission in this way: "Even when water power in large quantities is available directly alongside suitable factory sites, the electrical distribution of the power may play a part of sufficient importance to enable it to supplant mechanical methods on account of its flexibility, which leaves the mill architect free to arrange his factory buildings to suit the requirements of manufacturing products, substantially untrammeled by those difficulties that always surround the transmission and distribution of power by mechanical means." Then after discussing the flexibility of the electrical distribution as compared with the inflexibility of mechanical means for distributing power, and pointing out the economies of central-station power generation and the concentration of power plants, he asks this question: "How far should such concentration proceed?"

In answer to his own question we quote: "These considerations indicate that concentration of steam-electric generating plants will afford considerable economies when the concentration is carried much farther than heretofore, provided large steam turbines are utilized as prime movers. The ultimate economy cannot be reached in a single factory plant, even when it comprises several thousand horsepower; and logical development leads beyond the present practice of concentrating the power units of each manufacturing establishment into an individual power plant. Economy and reliability of power service are both to be obtained by further concentrating such individual power plants located in a compact industrial center into one or more great central stations, each of which provides power for a number of establishments."

Cost of Power in Machine Shops

With specific reference to machine shops, Professor Jackson presented these figures: "The usual round estimate of the cost of power in machine shops and the like is $60 per horsepower per year—taking the average power during working hours, perhaps 9 hours a day on the average. The cost is probably fully that large, and the power in machine shops seldom exceeds a couple of hundred horsepower and often does not exceed one hundred horsepower. The load factor is also rather low. Under more favorable conditions, large reductions may be made compared with this figure."

Mr. Main's paper was particularly devoted to textile mills and, therefore, will not be referred to in detail here.

Mr. Hale summarized the advantages of supplying electrical power from large central stations to industrial establishments as follows: "1. Central station power can, except in very unusual and special cases, be supplied more cheaply than when a man in another business attempts to make power as well as to carry on his own business.

"2. Central station power is practically always better and gives the private owner more freedom and flexibility than when he ties himself to his plant.

"3. Existing central stations have in the past figured the cost of their power supply in large lots too high, and have unconsciously hurt themselves with the public by attempting to charge large customers too much.

"4. When central stations have made proper prices, the people who do other kinds of business have hurt themselves and the public by figuring their own cost of power too low, and not charging their own time and general expense against the added business responsibility of the plant."

Factory Lighting

G. H. Stickney presented a very readable paper on the subject of illumination for industrial plants. From this paper we make rather extensive quotations.

"Figures have been published which show the relative rate of production by daylight and by artificial light in particular installations. In every case the superiority of daylight has been startlingly demonstrated. Unquestionably in the majority of manufacturing plants today, raising the standard of illumination would justify its cost, in the improved quality and quantity of production. Many factories are operating by old and inefficient methods, where the use of modern apparatus and methods would actually show reduced operating cost with improved illumination."

The Workman with Relation to Artificial Lighting

"The operative is an important factor for consideration in any lighting proposition. Since the light is provided primarily for his use, in order that he may perform his work advantageously, it follows that it should be suited to his needs. To be satisfactory the illumination should enable the workman to perform his work quickly and well, without excessive eye strain. The illumination can increase his efficiency by making him at ease with his surroundings, or can render him dissatisfied.

"It is seldom practicable to equal daylight, and therefore is usually advantageous to call as little attention as possible to the artificial lighting. One of the current objections to placing a small portable light under the control of the workman is that he is inclined to experiment with it, not only wasting his time, but often placing the light so as to produce a glare in the eyes of his fellow workman or himself. Such an arrangement is soon followed by eye strain, and the workman feels the desire for more light. An increased light only makes matters worse, and at the same time calls for higher current consumption. We have revised such installations when it was possible, cutting the current consumption in two, by going to general illumination and still providing ample working illumination.

"Such a change is usually resisted at first by the workman, partly because the strained condition of the eye makes it require more light for clear vision, and partly because the workman thinks an inherent right is being taken from him. If the change can be made diplomatically, providing additional intensity for the first few days, it is not unusual that a considerable reduction can be made, and at the same time a light furnished which is really better for the employee. In making such a change the operator should understand that the new system is an accepted success elsewhere. If it is treated as an experiment and the workman's opinion asked, he is apt to become over critical."

In spacing and arranging lamps in a room, these two points are worthy of consideration. The lamps should be spaced one and one-half to two times as far apart as the hight above the work, and it is wise to favor those parts of the room which have the best daylight, because in arranging operations and processes those requiring the best light are naturally located near the windows.

General Illumination

The general illumination for factories was presented by Mr. Stickney in these words: "There are two principal ways of lighting a room; namely, by local illumination and by general illumination. Where the former method is followed, a small lighting unit is placed at each point

where particular illumination is required, the remaining parts of the room depending on stray light or a low general illumination. For general illumination, the room or section is lighted by systematically placed units, so arranged that all parts receive approximately the same illumination. Relatively large lighting units are used, depending in size upon the dimension of the room and degree of illumination required.

"General illumination does away with temporary construction and unsightly drop cords, and the accompanying high depreciation and, in many cases, fire risk.

"The use of drop cords among stock shelves is especially to be deprecated, on account of tendency to put the lamp down where there is danger of causing fire. With properly labeled shelves, a permanently installed lamp above the aisle will provide the necessary illumination. When it is necessary to look under the shelf, a hand mirror can be used.

"When lighting processes in an open room, general illumination can be used economically where work is concentrated, but where there is just a few widely separated points which require light the method of local illumination will be the cheaper. The choice between the two methods often depends upon the process. General illumination gives a softer and better diffused light, but will not furnish light in a deep boring as readily as a specially placed local lamp. General illumination permits the use of most efficient illuminants, with least wiring and maintenance expense.

Machine Shop Lighting

"In machine shops general illumination can ordinarily be used to good advantage, although some special operations require local lighting. Such local lighting is sometimes provided by loaning extension lamps to the workmen on checks, after the practice followed with tools. This practice is often used for automatic machinery, where a special light is required for setting up, though a low general illumination is suitable for regular operations. Ordinary machine-shop work requires about 3-foot candles, though for rough work 1-foot candle is often satisfactory, while for fine work 6- or more foot candles may be required.

"The presence of many overhead belts makes the elimination of shadows with general illumination more difficult, and is also apt to be destructive to drop lights. Modern shops use as few overhead belts as practicable.

"In drafting rooms at least 6-foot candles should be provided on the drawing board. The selection between general and local illumination depends upon the arrangement of the room and other conditions. Where local lighting is used lamps should be shaded so as to cut off glare, and if possible located out of the draftsman's reach over the table a little to his left."

Current and Voltage

"The circuits for feeding factory lighting are usually determined by the central-station current available, or the requirement of the electrical motors of the plant. Either direct or alternating current can be used to equally good advantage for lighting, except that arc lamps do not give a steady light on 25-cycle circuits. Whenever possible the voltage of the lighting circuit should be between 110 and 125, as the most efficient lamps are more readily applied to these voltages. A 220-volt, three-wire circuit is commonly used to advantage."

Lamps for Industrial Lighting

Mr. Stickney pointed out that there are several types of incandescent and arc lamps available for industrial illumination, but that none of these lamps is suitable for all conditions of lighting. Thus it is often desirable to use several types in the same plant.

"The carbon incandescent lamp has a high specific consumption and is economical only with very low price of power or in small portable units. As it will stand rougher handling than any of the other forms, the carbon lamp is ordinarily used with extension cords.

"Tantalum lamps are finding a considerable use in manufacturing plants especially where direct current is available.

"The tungsten lamp has practically revolutionized commercial lighting and is now being extensively adopted in industrial lighting, especially in textile mills.

"Inclosed carbon arcs, both direct and alternating current, are used to a large extent in industrial lighting. They are efficient as large units and have a very low maintenance cost. For the higher grades of lighting they are very often equipped with fuses to soften the light and direct it downward.

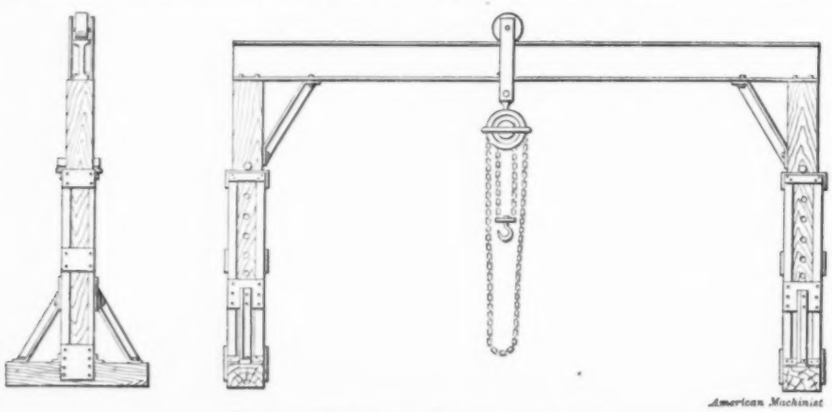
"The flaming arc lamp, using a so-called yellow carbon, after several years' use primarily as an advertising light, is now being used to a considerable extent for the lighting of foundries, machine shops, etc., where the rooms are high and where it is desirable to hang lamps above the crane.

Handy Home Made Erecting Crane

By Charles Collins

Recently I happened to be where a new light and power plant was being installed. As the parts of the machines were cumbersome and heavy to handle the erecting crew were provided with a light and handy portable traveling crane of home-made construction, which seemed to be the acme of convenience.

It consisted of a ten-foot length of I-beam supported by two 6x6-inch timbers, which telescoped into light, well braced frames of angle iron, thus permitting the beam to be raised to a hight suitable for the job. A traveler and a chain tackle completed the outfit.



Handy Homemade Erecting Crane

Stevens Institute Alumni

The 9th annual dinner of the alumni of Stevens Institute was held at the Hotel Astor, New York City, on February 12 and was attended by nearly 300 men. President Humphreys presented his program for the development of Stevens and made a plea for the money necessary to carry out the proposed plan. He announced that $63,500 of the $1,250,000 which he expects to raise has already been received. This is to be used for the purchase of the Castle Point estate, for the erection of several buildings, including a mechanical laboratory, an electrical laboratory and a dormitory, as well as to provide an endowment fund.

March 3, 1910.

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American Machinist

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION

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Pending Patent Legislation

Among the bills dealing with patent legislation, that have been introduced at the present session of Congress, are two that are especially worthy of consideration and support. One of these is a bill to establish a United States Court of Patent Appeals; the other a bill amending and revising various sections of the revised statutes relating to patents, and in particular providing for the elimination of one of the appeals within the Patent Office.

In regard to establishing a court of patent appeals but little needs to be said here, as the subject has been presented several times in our columns. The bill, R. H. 14,622 and S. 4982, provides for a court of appeals for patent cases organized and conducted similarly to the Supreme Court of the United States; having a chief justice appointed by the President and four associate justices, designated by the chief justice of the United States Supreme Court. The decisions of this court shall be final, except that the Supreme Court of the United States has the power of review.

The establishing of this court, especially constituted to consider patent cases on appeal, should work immediate good in lessening the delays in such cases, and in constituting a court whose justices will become experts in considering the complex technicalities surrounding the questions involved in much patent litigation.

The bill to revise and amend certain statutes relating to patents is H. R. 18,885 and S. 5636.

At present there are two appeals within the Patent Office. The first—in an interference case for example—is from the examiner of interferences to the board of examiners-in-chief; the second from this board to the commissioner. In addition, there is an appeal outside of the office to the court of appeals of the District of Columbia. Thus there are three appeals in all.

The passage of this bill will eliminate one of these appeals by constituting a board of appeals in the Patent Office, comprising the commissioner of patents, the first assistant commissioner of patents, the assistant commissioner of patents and the examiners-in-chief, any three of whom at the designation of the commissioner shall constitute a quorum of the board.

The establishing of this board of appeals, that is, the elimination of one appeal within the Office, should shorten the time required for the ultimate disposal of appealed cases, and should effect a considerable saving of expense to applicants.

A more careful consideration should be given to appeals after this change, for the number of appeals is now so great that the commissioner is hampered to find sufficient time to give a proper amount of personal attention to each case.

The present board of examiners-in-chief consists of three members and no provision is made by law to supply a temporary vacancy caused by sickness or absence. The absence of one member often results in an evenly divided board with a consequent necessity for a rehearing. With an appellate board constituted as set forth in these bills, a quorum would always be assured for there are six members, any three of whom at the designation of the commissioner constitute a quorum; thus careful joint consideration would seem to be assured.

Furthermore, with only one appeal within the Office instead of two, a greater stability should be given to the decisions.

These bills undoubtedly shape an important plan to expedite patent litigation and the granting of patents to inventors. They are directly in line with the broad movement that is now shaping itself toward a minimizing of the law's delay.

Anyone who is interested in stimulating real invention and in patent reform, can help the cause by writing to his representative in Congress urging passing of these bills.

CIRCULATION STATEMENT

During 1909 *we printed and circulated* 1,209,000 *copies of the* AMERICAN MACHINIST.

Our circulation for February, 1910, *was (American weekly, American monthly, English weekly and German weekly)* 109,250.

March 3..... 40,250

This paper reaches 40,250 *separate readers each month and* 23,750 *each week.*

None sent free regularly, no returns from news companies, no back numbers. Figures are live, net circulation.

Contents

PAGE

Modern Automobile Building Methods in a French Shop..... 383
Pittsburg Finish..... 388
Good Work in Manufacturing Speed Lathes 389
Methods of Handling Automatic Turret Work 391
A Mill and a Little History..... 397
An Effective Process for Burning Fuel Oil 398
Worcester School Ma'ams and Industrial Training 399
An English Drafting Room and Efficient Costs System..... 400
Automobile Practice in the Chadwick Engineering Works..... 404
A Simple Electric Light Fixture for Board 405
Machining Large Work by Unusual Methods 406
Bushing for Screw Machine Collets..... 410
Automatic Machinery as Used in Office Work 411
Letters from Practical Men:
Practical Hints in Gear Cutting....Adjustable Steps for Jigs and Fixtures....Fixture for Milling Cam Slots....Drawing Duplicator....414-416
Discussion of the Previous Question:
Multiple Housings for Large Planers....Financial Mechanics of Aviation....Ball Bearings and Methods of Testing....Semi-automatic Metal Trimming Machine....Precision Slide Rule 417-418
Engineers' Meeting in Boston..... 419
Pending Patent Legislation..... 421
Rigid Inspection vs. Horse Sense..... 421
Just a Business Proposition..... 422
New Tools and Machine Shop Appliances 423

Rigid Inspection vs. Horse Sense

Few will deny the necessity or the desirability of inspection in modern manufacture nor is it an easy task to say just how far it should be carried, yet there is a growing feeling that it is barely possible that we have carried it too far in many cases.

When parts are made to gages and every screw is tried in a gage before going to the assembling room, the machines go together with very little fitting and duplicates can be supplied without difficulty. Then we adopt the stock phrase of excellence "inspected for a

thousandth variation" and write our names large on the list of real manufacturers of high-grade machines.

But there is another side to the story. We get the inspection fever so badly at times that we become delirious and overlook two important points. One that while gages may be positive, inspectors are not and the other that we are wasting precious time and money in useless inspection, or in the adoption of limits that are utterly absurd for the work in hand.

We pay good money to toolmakers to make gages that are right and then hire inspectors to use them who have no notion of what intelligent inspection really means. When a man is out of place in any other department he usually winds up in the inspection room or we hire some docile individual who looks harmless and understands that limit gages were made to "go" or "not go" as the case may be. But unfortunately we have no gage yet in use which will register the amount of pressure used to force it over the work. As a consequence we are apt to get pieces of different sizes passed by the same gage in the hands of different men or by the same man, depending on the condition of his muscle.

The regular inspector, even if of more than average ability, can hardly be allowed much if any discretion beyond the limit of his gages, and yet we all know of countless cases where a piece is rejected which is just as good for its purpose as though it were a half or quarter thousandth, larger or smaller. The remedy here would seem to be to have one or more inspectors with discretion, to simply examine rejected pieces and see how many of the defects were vital. This is not a plea for any laxity of real inspection, only the prevention of needless and costly waste which is now done in the belief that the product demands it.

Where parts fit each other, the limit of variation must necessarily be small to secure satisfactory results, but where they simply come in contact with the surrounding atmosphere, the limit can be considerably larger without undue air pressure in the universe. Yet we find limits held almost as close where there is no fit as where the parts come together. We know of one automobile flywheel where the limit of the thickness of the web is held to a thousandth of an inch.

It is contended that cases of this kind are not so much to keep the parts exactly alike at non-essential points as to its moral effect on the men; that if they are kept to close limits on everything the general results are much better. We do not consider this point well taken.

There has been much complaint that it was difficult to find men who knew how to do just the grade of work that was required. That they would do fine toolmaker's work on a pump repair job or rough work on a tool job, which is too true in many cases. But is this not just the result you would expect from an unvarying limit of accuracy, regardless of the necessities of the case? When a man is held to a close limit where his common sense tells him an eighth of an inch would not affect its operation, he thinks and says things which are more forcible than elegant, and loses respect for the judgment that declares such limits necessary.

We believe the moral effect of unnecessary accuracy as of unnecessary restriction of any kind is distinctly bad. Make reasonable limits and stick to them but let the limits be in accord with the practical necessities. It is much easier to make ten-thousandth fits on the drawing board than in the shop. Select inspectors who know the rudiments of the work at least and have them in charge of competent men. Then let all departments pull together and we believe the losses from properly rejected work can be materially reduced.

Just a Business Proposition

Two years ago a committee of Senators and Congressmen spent some months investigating the postal situation. They took nothing for granted but looked into every nook and cranny that was open.

This commission decided that no reliable data were available and that most of the figures given were estimates."

They found that very few improvements in the business methods of the Post Office Department had been made in a hundred years.

They found the largest business in the world run with antiquated methods, that the responsible positions in this vast machine were in the hands of politicians, that red tape clogged the wheels of progress and that, unlike any other business concern, they were trying to economize by cutting down the volume of their business rather than increasing it.

This committee offered a bill to Congress, known as the Overstreet bill—but Congress had other fish to fry and no action was taken.

This bill provided for the appointment by the President of a nonpolitical Director of Posts, who shall not be removed except for cause, and for a reorganization of the Postal Department along modern business lines.

Senator Carter has reintroduced this bill, and it ought to pass.

It makes no snap judgments on "estimates." It provides that the department be put on a business footing first and remedies applied after it is known what is the matter with it.

The increase of magazine postage is not needed—the deficit increased $18,000,000 on a *decreasing* second-class mail.

There is something rotten in Denmark—we think it is just departmental dry rot.

There have been some seventeen Postmasters General in the past twenty years. To change the head of any big private business concern that often would break it. Fortunately the Postmaster General just rattles around in his job and the clerks carry on the work and make out their reports—and his.

Then he proposes—but the people dispose.

And the people of this country want their newspapers and magazines just as cheap as they can get them and they are getting tired of some things in our antiquated post office.

For instance, they are wondering why our department can make arrangements to carry a parcel from Seattle via New York and on to London or Paris or Berlin for 12 cents a pound *and charge* 16 *cents a pound to carry the same package to Tacoma, or even across the street.*

They are tired of the trade our post office made with Canada increasing the rates on second-class matter to our neighboring country to the detriment of our trade there. They are tired of such acts as the recent reduction of 80 *per cent.* on foreign-going letters—and a howl about a deficit in the same breath.

If parcels posts are good for the foreigner they are good for us.

If the postage on the letter that carries the money order back to Italy should be less, why should the postage on the paper that tries to make an American citizen of another Italian be more?

A respectful letter from any business man to his representative in Congress asking him to support the Carter Bill (Senate Bill 6287) will receive attention.

Let's look over the books before we shoot somebody for embezzlement.

New Publication

BY STARLIGHT AND MOONLIGHT. 40 pages, 6x9 inches published by the Warner & Swasey Company, Cleveland, Ohio, 25 cents.

Coming at this particular time when there are comets to be seen, this little book makes an interesting introduction to a very fascinating study. It takes up single and double stars, the planets and the moon and is illustrated with a number of guide maps and two excellent halftones of the moon. While it also calls attention to the prism terrestrial telescope made by this company, it is none the less valuable on that account. If, as many assert, every man should have a hobby in addition to his regular employment, we can think of none which would be more fascinating and less injurious than that of star gazing.

New Tools *and* Machine Shop Appliances

Showing New Ideas *in* Machine Shop Equipment *that* make *it* possible *to* do better work at a reduced cost

Power Shearing and Punching Machines

Fig. 1 shows a belt-driven machine for shearing angles, squares and rounds.

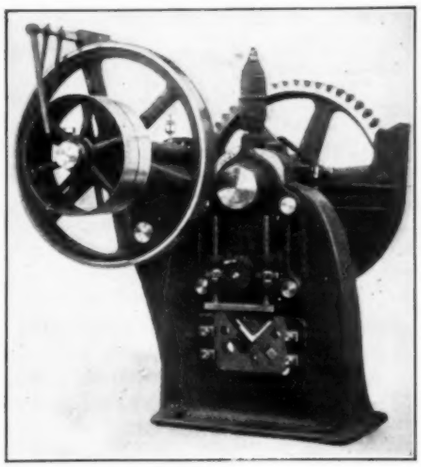


FIG. 1. A SHEAR FOR ANGLES, SQUARES AND ROUNDS

This machine is built in several sizes to shear rounds up to 3 inches diameter, squares up to 2 5/8 inches and angles up to 7x¾ inches. Shears for T's, channels and other structural shapes can also be supplied.

Fig. 2 shows a machine for the same

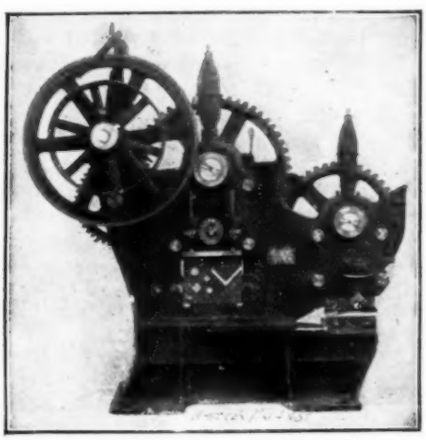


FIG. 2. SHEAR FOR ANGLES, SQUARES, ROUNDS AND PLATES

purpose as that shown in Fig. 1 but with the addition of a plate shear. The shear will handle plates up to 1¼ inches thick.

Fig. 3 shows a machine, similar to that shown in Fig. 2, provided with a punch. These machines are made in various sizes

ANY new or improved machine or shop appliance of interest to our readers will be illustrated and described in this department.

A full and more detailed description will be given—when of special interest and it appears here before being sent elsewhere.

ALL descriptions appear in all four editions of the paper—Weekly, Monthly, Weekly English and Weekly German.

with throats up to 32¼ inches deep and of sufficient power to punch a 2-inch hole in 1 9/16-inch plate.

All parts subject to strain such as the frames, caps of the slide, couplings, etc., are made of steel castings. The shafts are made of tempered steel and run in phosphor-bronze or cast-iron bearings

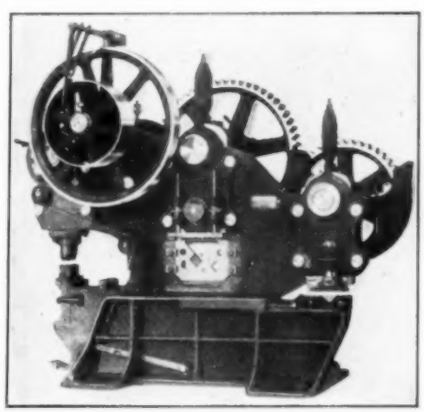


FIG. 3. PUNCH AND SHEAR FOR PLATES, ANGLES, ROUNDS AND SQUARES

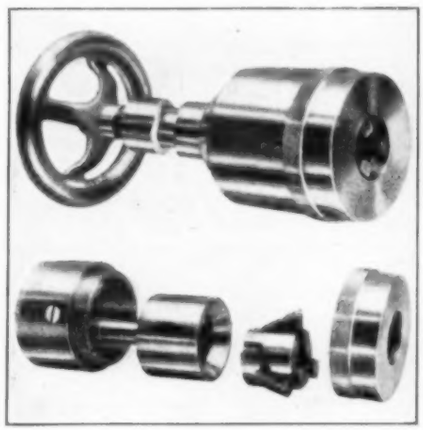
according to their respective duties. Motor drive can be applied to any of these machines. They are built by the Carpenter-Kerlin Gear and Machine Company, 77 White street, New York.

A New Set of Swedish Gages

The Grönkvist Drill Chuck Company, 18 Morris St., Jersey City, N. J., has brought out a new set of the Johannson gages. This set comprises 28 blocks, a pair of half-inch plugs, for internal measuring and a 2-inch holder. With this set measurements by increments of 0.001 inch can be made.

A Draw-in Attachment

The halftones show an adjustable spring collet and draw-in attachment. The spring collets are applicable to any make of screw and turret lathes and the



ADJUSTABLE SPRING COLLET AND DRAW-IN ATTACHMENT

draw-in attachment to any make of engine, speed and turret lathes provided with hollow spindles. The spring collet being adjustable, will take the place of a full set of the regular one-piece spring collets.

The hood at the left in the lower figure, is threaded to fit the spindle of the lathe. The operating sleeve fits in the hood and the gripping jaw holder fits in the sleeve. All these parts are held together by the steel cap shown at the right in the cut. All the working parts are hardened and ground. The device can be furnished with either three or four jaws, or with stepped jaws for flange or similar work.

These collets and draw-in attachments are made by the Cleveland Chuck Company, Cleveland, Ohio.

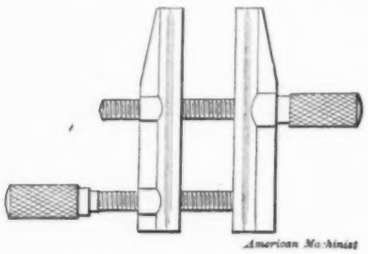
Toolmakers' Vise

The Brown & Sharpe Manufacturing Company, Providence, R. I., is making a toolmakers' vise which is particularly convenient for drilling, fitting and laying out work on surface plates and for similar uses. It is of steel, case hardened and has a maximum capacity of two inches, being strong, yet light and convenient to handle. There are two auxiliary jaws which can be slipped on and off the end of the screw to aid in increasing or reducing its capacity. The screw itself is hardened and has a short slid-

ing bar that is fitted through a nurled nut at the end. There is also a V-slot which is very convenient in centering round bars and in other work where these slots are generally used.

A Machinist's Clamp

This line of handy little tools, of which the smallest is shown in the halftone, was brought out to meet the demand for

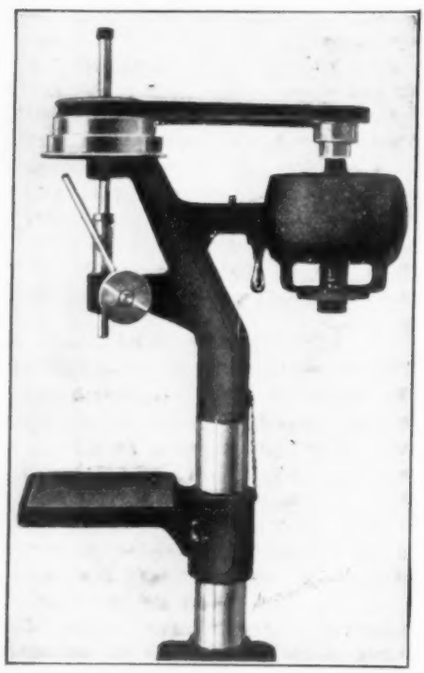


MACHINIST'S CLAMP

a low-priced clamp. Made of sheet steel pressed to shape, they are strong and light. The jaws of the clamp shown are 2¾ inches long and will take 1¼ inches between them. They are made by the Tower & Lyon Company, 95 Chambers street, New York.

A Motor Driven Bench Drill

The halftone shows a 12-inch motor-driven bench drill press. The motor is adjustably mounted so that stretch in the belt may be readily taken up. The table is counterbalanced and can be swung around out of the way.



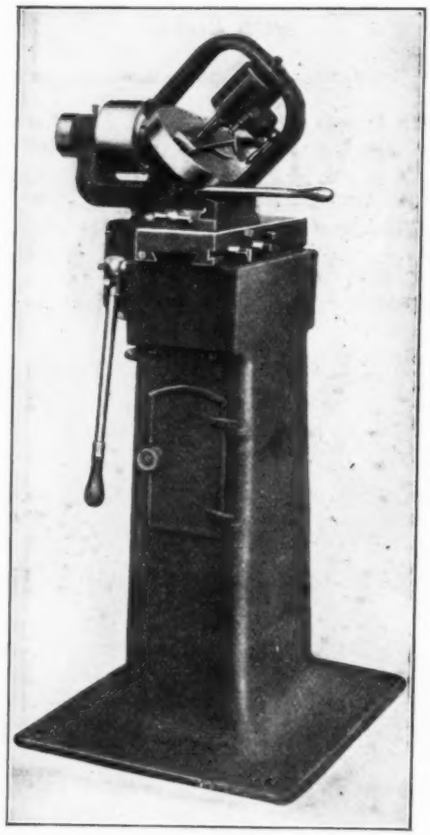
MOTOR-DRIVEN BENCH DRILL

Greatest distance from spindle to table, 14 inches; traverse of spindle, 3 inches; table, 8x10 inches; weight, 180 pounds; maximum horsepower of motor 1/3.

This machine is built by the Willey Machine Company, Jeffersonville, Indiana.

A Piston Ring Milling Machine

The machine shown in the halftone is for milling the 45-degree angle slots in piston rings. The rings are clamped to the table by means of the air-operated clamp shown in the halftone. The machine shown will handle rings up to 8

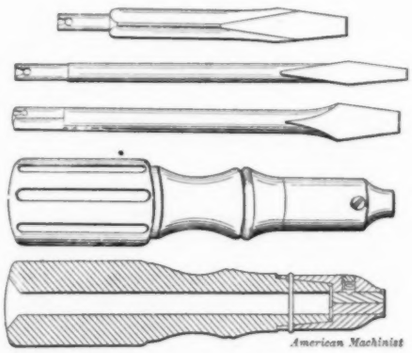


A MACHINE FOR MILLING ANGULAR JOINT SLOTS IN PISTON RINGS

inches in diameter. The rings are located by suitable plugs on the angular table as shown. The air clamp requires a pressure of from 60 to 80 pounds to operate it. This machine is built by Ackley & Abbey, Battle Creek, Mich.

A Screwdriver with Interchangeable Blades

The screwdriver shown consists of a handle which fits all the blades, they being retained by a small spring pin shown in the sectional cut of the handle. The blades are made in two styles, round and square and in two diameters of each style, i.e., 5/16 and ⅜ inch. The round blades are supplied from 1 to 36 inches and the square from 1 inch to 12 inches in length. The shanks of the blades being square, they fit any bit stock. The



THE HANDLE AND THE BLADES

wooden handle is reinforced by a steel shank running the entire length as shown. The tools are made by the Tower & Lyon Company, 95 Chambers street New York.

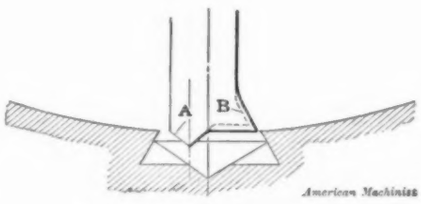
A Tool for Dovetailing Holes or Grooves

BY M. JACKES

Sometimes it becomes necessary in caps that are to be babbitted, and where the dovetailed grooves or holes that hold the babbitt have been omitted in the casting, to drill them in afterward.

The sketch shows a method of dovetailing these holes not generally known.

The size given might be used on 6-inch boxes and up. Drill about ⅛-inch deep with a ⅝-inch drill, then follow up with the tool as shown just entering the hole The heel of the tool *A* is rounded off



DRILL FOR UNDERCUTTING

slightly so as to do no cutting, but rides around pushing the cutting edges into the casting and forming the dovetail. The tool must be sufficiently long to spring ⅛-inch, which it has done when it gets to the bottom. The dotted lines *B* indicate the clearance on the cutting edge.

Foreign Trade in Machine Tools

By an American Salesman

The foreign business admittedly in all "protected" countries is secondary to the home trade, in fact may be called "overflow business." After a manufacturer has supplied the home trade he then, and only then, looks further afield. The question arises as to which is the better method to adopt—install and maintain a representative in the foreign market, or give the agency to a first-class accredited machinery merchant.

In my opinion the latter method is better by far, that is if there are real live men at the head of the agency and the same kind of salesmen on the road.

The Special or Single Line of Machines

The consideration of this subject may be narrowed down to manufacturers making a special and one line of machine tools. In such cases it would seem advisable to establish and maintain a direct representative abroad, and exclusive of machinery merchants. Yet in such cases the machinery merchants might take care of the business in a better way. If these special machines are good tools and labor savers, the salesman finds no difficulty in selling them; that is, if he can get hold of the machines in a reasonable time. Herein is the whole trouble—the difficulty in times of prosperity in getting hold of good machinery to sell. The experience of many years confirms this statement. As regards this item, my experience is that business is usually brisk in all countries much at the same time, and by past experience, deliveries of machines ordered for foreign shipment depend very largely on factors at home. In many cases the foreign user is allowed to wait an unreasonable time even after promises have been made, owing to the manufacturers giving home users the preference and getting the agent's commission himself, besides causing hard feeling between the agent and customer, to say nothing of the loss inflicted in prestige as regards future business. Of course, manufacturers do not complain in brisk times, but only in dull times, and these depressions generally take place the whole world over at the same time.

Now what could the special representative do in such times of dearth? He might keep busy prevailing on customers to *wait* for long deliveries—a costly and absurd state of affairs.

At this time it might be well to consider the cost of maintaining a direct representative.

These figures are formidable looking, but the experience of many manufacturers in America will confirm the nearness of the estimate, and if anything this estimate is on the low side.

Considering the case of one territory only, that of Great Britain, with the cost of maintainance at £2000 per annum. It would be necessary for the special representative to get £20,000 of business to justify his existence. This amounts to selling 100 machine tools at £200 ($1000) each per year, or two per week. This may be called a normal year. This estimate is a very fair consideration, and a state of things which ought to be obtained if direct representation is adopted.

Now supposing six territories secured that same amount of trade it would equal £120,000 per annum ($600,000) or 600 machines at $1000 each per year, or two per day, and if the price per machine be $2000, the output equals one per working day. This would be a magnificent "foreign" business, *reductio ad absurdum*. The partial success of three representatives out of six would be a financial failure to the whole scheme.

COST OF FOREIGN REPRESENTATIVES IN THE CASE OF GREAT BRITAIN.

	Cost per Annum.	
Representative's salary	£500	$2,500
Representative's expenses, rail and hotel	£400	$2,000
Representative's commission, 2 per cent. on £20,000	£400	$2,000
One operator	£150	$750
Operator's expenses, rail and hotel	£200	$1,000
Typist	£70	$350
Clerk, bookkeeper and cashier (combined)	£100	$500
Odd boy	£25	$125
Telephone	£15	$75
Rent and rates for office	£50	$250
Extras—telegrams, postage, office supplies, storage of machines, advertising by mail and otherwise, repairs to machines and alterations to tool equipments (no bad debts); say	£100	$500
	£2,010	$10,050

Country.	Cost per Annum.	
Great Britain	£2,010	$10,050
Norway, Sweden, Denmark, Russia	£2,000	$10,000
Holland, Belgium	£2,000	$10,000
Germany, Austria	£2,000	$10,000
France, Switzerland	£2,000	$10,000
Italy, Spain, Portugal	£2,000	$10,000
Grand total	£12,010	$60,050

If the business were in the machinery merchant's hands the cost of selling £20,000 worth would be equal in both cases, with the difference that the manufacturer takes no risk of bad debts.

Now if the trade were below normal for any one year, the manufacturer would still be charged with £2000 selling expenses, to support the direct representative (in fact the expenses of selling tools increase when business is hard to get), and the charge would stand just the same even if the business were nil; whereas, under like conditions, dealing with machinery merchants, the expenses are proportionate to the orders, and no such charges are being made when the business is nil, which is equivalent to saying that in the former case the manufacturer has to get $100,000 more home trade to support the foreign representative.

A recent *Daily Consular and Trade Report* contained a long article, that has been extensively reprinted, extolling the grand success of an American firm that adopted direct representation in France. Business amounting to $1,000,000 was turned over in five years, selling 400 special machine tools, which equals $2500 (£520) each. This price one presumes includes some equipment and the tariff. Such phenomenal success is attributed to direct representation. Is it due to the value of the machines, or only to the salesman himself? or perhaps a combination of both? Now the question presents itself—should not the same combination produce the same results if used in connection with machinery merchants? The answer can only be in the affirmative.

Then again, the years referred to in which the business was done were when the motor-car trade, a new industry, was at its best; a parallel with the cycle boom. Such floods of business, like the recent Paris floods, subside naturally, and such abnormal conditions cannot serve as a guide.

Further, direct representation is not a new thing as the article referred to would indicate. It has been tried by manufacturers before, much to their regret in nearly all cases. The scheme may be all right in good years, but it does not pan out taking averages.

The foreign machinery merchants are not as perfect as could be desired, neither are the machine-tool manufacturers; but so long as the foreign merchant keeps uptodate and alive to the value of the machine tools to his customers, quick to catch up new developments in the machines he handles, there should be no reason to make a change.

Difficult to Get Salesmen for Machine Tools

The men selected to sell for the merchant should be practical machinists, gentlemanly men in a way, men with tact and wide experience combined with commercial experience, but the crux of the whole thing is to find a successful salesman in machine tools. The machinery merchant and the manufacturer are agreed on this point. When such men are found it behooves the merchant to appreciate the success by securing them to the company with an invested interest. The subject of the kind of men cannot be treated fully here as it raises the topic of specialist *versus* all round man, but the merchant is quite as capable of securing good men as the manufacturer.

As regards direct representation, this can only be accomplished in special machinery; such tools as drills, lathes, shapers, planers and others of a similar character in any event would not pay for direct representation. It is only where some new special machinery is evolved for certain industries in which quantities are required, that direct representation would have a look-in in any event.

Speaking as one who has had experience in buying, selling and manufacturing, there is still room for the much abused merchant, and in many cases he fills a want which cannot be accomplished by direct representation. At the same time the merchant is a godsend to manufacturers when they want to load him up with machinery which they have had canceled by their own customers who cannot take the goods, which are then shipped off to the foreign merchant, knowing that he can be drawn against in 60 days.

Patents and Present Patent Law Procedure

By J. C. Howell

To patent is to make public. That is the first meaning of the word. The term "Letters Patent" means a document explaining and setting forth all the details of the matter it refers to. The term is applied to the grant of some right or other that would not exist, or else that could not be properly proved, without the grant. With reference to inventions, it is supposed to mean the grant of the exclusive right to make, to use and to sell articles covered by the invention.

Observe that I have said, *is supposed to.* In form it does so, for the patent uses those very words. And this is the general conception of its meaning. As a matter of fact, a patent grants nothing. It is merely a recognition of a moral right that already exists in such form that the possessor of it is given a slight advantage in bringing suit. A patent is an acknowledgment by the Government that so far as it is able to learn after diligent search, the inventor has discovered something new which he is entitled to possess; and that so far as its courts are concerned, anybody who doubts the fact will have to prove his case.

Ordinarily, anybody who claims a right must prove it before the court will acknowledge it. But in the case of a patented invention, the court will acknowledge the right on the strength of the patent, and throw the burden of proof on anyone who disputes it. That is all there is to a patent, absolutely all.

The Occasional Profitable Patent

Occasionally you hear of an immense fortune being made out of a patent. Occasionally there is such a case; but in ninety-nine such cases out of a hundred, a fortune was spent in law suits over the patent before one cent of profit was made. The other one case out of a hundred is the one that you have heard about and that has excited your imagination and given you the impression that a patent is bound to be a veritable gold mine. The puzzle game of Pigs-in-Clover was an instance of this. Nobody was likely to dispute the right to the invention because the chances of disputing it successfully were very small; and moreover the fortune was made in less time than it takes an ordinary patent suit to go through the courts. It is unfortunate that the popular idea of a patent is based on an occasional spectacular instance like this. The usual course of a patent is far different, and as a rule a patent is useless to anyone who has not ample funds at his command to establish it by means of a tedious and expensive series of court decisions.

Does this seem to be unjust? But the law cannot always do immediate justice, and cannot always do final justice in every case. The law of England, from which our law is copied, is based on the principle of the greatest good to the greatest number.

In granting a patent, the United States Government grants the right to sue in the Federal courts on the mere statement of the facts that the patent had been granted and that the defendant has infringed. The defendant is then at liberty to prove that he has not infringed, or that the patent was not properly granted. If he can prove that the patentee is not the first inventor, or that the invention is not the same thing that he has made, used or sold, there is no redress. It is right that this should be so, or we would find ourselves prevented by patentees from doing a thousand things that in justice we ought to be allowed to do. There are two sides to the case, that of the inventor who is claiming exclusive privilege in one thing, and that of the public which already has an absolute right to everything under the sun that is not patentable.

This view of the situation puts rather a different light on it. There is danger that in attempting to protect the inventor, the public will be defrauded. So there is no injustice in saying to an inventor, "You are entitled to exactly as much as you invent, but no more; and although we believe that you are entitled to this specific thing, we will allow any member of the public to dispute it, and to disprove it if he can."

Patent Procedure

When an inventor wishes to secure this protection, he applies for it to the United States Patent Office. The application consists of three parts: A petition addressed to the United States Government through its commissioner of patents, asking for protection; a description of the invention, with drawings if necessary, and a series of claims, so-called, stating precisely how much and what part of the invention is presented as new and original and therefore belonging of right to the inventor; and an affidavit that the things claimed are really his invention, so far as he is aware. The Patent Office examines the drawings and specifications to make sure that they properly describe the supposed invention. Then it examines the claims in connection with everything that was ever done or written or spoken on the subject. If the Patent Office thinks it has found the same thing elsewhere, in this country or in any other, recent or ancient, in use or buried under mountains, it will refuse to grant the claims and give its reasons. The inventor may answer, and if he can convince the Patent Office that he is right his claims will be granted. If not, they will be refused, in whole or in part.

When a claim has been rejected, it may be redrawn so as not to include so large a right; but when that is done, it is equivalent to an acknowledgment by the inventor that he is not entitled to the portion of the invention thus surrendered. If he is not satisfied when a decision is made against him he may appeal from the examiner to the examiner-in-chief, from him to the commissioner of patents and from him to the United States Court of Appeals. In certain cases an appeal may lie to the Supreme Court of the United States.

Thus, at the beginning, the Government is careful to say what it will allow the inventor to claim in court without further proof. A patent may be as big and strong as Gibraltar, or it may be about as big and strong as the paper it is written on. The Government does not attempt to pass on the value of an invention, and a man may patent practically anything that he invents, however worthless it may be. It follows that a patent may be something of immense value or it may be rubbish. A large proportion of the patents issued are rubbish.

Two Common Sayings

There are two sayings current among business men: "To buy a patent is to buy a lawsuit"; and, "A patent is worth what it has cost." It costs ordinarily from

seventy-five to a hundred dollars to secure a patent on a fairly simple device. On complicated inventions, the cost may run up into thousands. But the first cost is only the beginning. If the patent covers a valuable invention, somebody is pretty sure to dispute it. That means a suit in the Federal court, with the very existence of the patent at stake. If the suit is decided against the inventor, his rights are reduced so as not to include the defendant's device. If the suit is decided in his favor, no new rights are granted but the ones expressed in the patent are more firmly established. Another man will think twice before he infringes, and a dozen times before he allows suit to be brought against him. After a second or third decision in favor of the patent, the court will seldom refuse to grant an immediate injunction restraining any supposed infringer. But a patent that has successfully endured three successive suits was exceptionally strong in the beginning, and has called for thousands upon thousands of dollars to defend it.

A patent grants no rights, but only confirms the moral right that any man has to the product of his own genius, and establishes him as the inventor, so far as the courts are concerned, until his claims can be disproved. A patent is an admission by the Government that according to all appearances the patentee is the rightful owner of the invention, and a declaration that he shall have it unless somebody can prove the contrary. If the fact could be generally known, how many dollars would stay in banks where they belong, how many false hopes would be prevented, how many heartaches saved!

A Draw Cut Thought

By R. J. Felix

One of the things which keeps the foreman of a country job and repair shop thinking all of the time, is how to perform certain and I may say frequently difficult operations on jobs that should go on larger tools for machining than those at his command, and that may or may not be to his advantage. It's all in how he looks at it.

The occasion for the foregoing remark was my being called upon, while in the above-named capacity, to make some repairs on a 2000 horsepower McIntosh & Seymour cross-compound engine and the small-tool question had us going for a while. However, we finally won out against the usual odds with which the small shop with small tools has to contend and the engine is running yet.

The cross-head on the low-pressure side of the engine became dry from some unknown cause and left the plant lame in its left foreleg; so lame in fact, that it was practically down and out until the babbitt could be chipped out of the lower half, relined, peened and planed parallel with the good or top side.

The job proceeded smoothly until the new lining was poured and peened, although I must say the way the metal (which was XXXX Nickel or better) was anchored in the face of that steel casting was perfect and the chipping of it out was one of my experiences. We deemed it impossible to melt the metal out with any means at hand without spoiling the good side; hence the chipping. However, all good or bad jobs have an end and we were soon up against the real problem of how to face the new lining parallel with the opposite side. Our only planer was a 22-inch Putnam that had served its purpose on more than one job that should have been done on a larger, heavier machine, but this was the last straw.

The cross-head was 24 inches wide by 24 inches long, and would not swing in our largest lathe, while the removing of one of the planer housings, bracing the cross-rail and thus improvising an open-side planer, entailed the loss of time which, when one is working on the engine that is the back-bone of a plant that furnishes a city of 35,000 population with light and power, is the most important item, so the planer as it was must do the job if possible.

We had a 2-inch round bar with a hole near one end for a 5/8-inch square cutter held by a set screw from the end of the bar. This was held in a bar holder which was in turn clamped in the tool post with a jack at the top to hold the clapper box down. This rig had been used with fair results in cutting key-seats in long hubs, and we tried it with a number of different shapes of cutters and varied feeds but to no purpose. The overhang of the bar was too great and we were about tired out, for we had gone to work on the job at 9:30 Saturday evening, and when this stage of the game was reached, it was 3:30 p. m. Sunday. We had then about decided to either widen the planer or express the job to a shop that could handle it.

Someone has said that our extremities sharpen our wits and as I despairingly watched the tool ride, gouge and dip into that tough metal, my thoughts turned to an advertisement I had recently seen in the American Machinist of the Morton draw-cut shaper and would I not make play of that job if I had it on a Morton for about an hour? Hold on! Why not turn that cutter around and make the old planer pull the cut on the return stroke? Happy thought! Nothing to it! You just ought to have seen that planer rise to the occasion. We took a light cut or two to allow for the spring in the bar and the new lining was as parallel with the other side as the most fastidious chief could wish.

PERSONALS

Items For This Column Are Solicited

Fahle Hammer, of the Grönkvist Drill Chuck Company, Jersey City, N. J., has just returned from a six months' trip abroad.

D. Mackenzie, formerly eastern engineer of Swift & Co., is now connected with the mechanical department of the Union Stock Yards, Chicago, Ill.

Mr. Moritz, of the St. Petersburg house of Schuchardt & Schütte, is now in this country. He will make a prolonged stay and will study American manufacturing methods.

M. R. Morrow, recently with the Lima Locomotive and Machine Company, Lima, Ohio, has accepted the general foremanship of the Russell Engineering Company, Massillon, Ohio.

Clarence E. Buxton, formerly production engineer for the Thomas Motor Company, of Buffalo, has accepted the position of superintendent of the James Cunningham Company, Rochester, N. Y.

George W. Martin, assistant editor of the American Society of Mechanical Engineers, has accepted a position with the Babcock & Wilcox Company, New York City, to look after their editorial work.

Roy V. Wright, for several years editor of the *American Engineer and Railway Journal*, has resigned to undertake the editorial management of the mechanical department of the *Railroad Age Gazette*.

E. G. Matter formerly connected with the western office of the National-Acme Manufacturing Company, has been appointed to look after the Detroit and eastern Michigan territory in the interests of his concern.

H. E. Obenshaw, secretary and treasurer of the Screw Cutting Company of America, Philadelphia, Penn., has resigned to accept a position in Roanoke, Va., as president of the Roanoke Iron Works, Inc.

H. P. Hoag, for the past two years superintendent of Fairbanks-Morse Canadian Manufacturing Company, Toronto, Ont., has accepted a similar position with the Goold, Chapley & Mien Company, Brantford, Ont.

The Baush Machine Tool Company, of Springfield, Mass., has been purchased by F. H. Page for the National Equipment Company, which also owns the stock of the Confectioners' Machinery and Manufacturing Company. Clarence J. Wetsel will remain as treasurer and general manager of the machine-tool department, Frank E. Bocorselski will be in charge of the engineering department and W. F. Wadleigh will be general superintendent. The manufacture of radial drills will be continued.

Increasing Shop Capacities

Where More Tools will be needed

The garage of Tynan & Reynolds, Paterson, N. J., was destroyed by fire.

H. E. Fitchie, Hot Springs, S. D., is erecting a two-story planing mill.

The Adams Patent Wheel Company, Cassville, Wis., will erect a factory.

The Grand Rapids (Wis.) Brewing Company will enlarge its bottling plant.

The Howell & Fincher Company, Atlanta, Ga., will establish a furniture factory.

The factory and foundry of A. E. Kupkey, Andover, N. B., was destroyed by fire.

The Cleveland (Ohio) Electric Illuminating Company is to erect a new power plant.

The Minnesota Woodenware Company, Cohasset, Minn., will erect a new sawmill.

The Whitehead Hosiery Mills, Burlington, N. C., will erect an addition to its plant.

The construction of a municipal light plant at St. John, Kan., is under consideration.

The Victor Safe and Lock Company, Cincinnati, Ohio, is to erect a plant in Norwood.

The Carrollton (Ky.) Furniture Company is to erect a two-story addition to its plant.

The plant of the Mt. Vernon (Ohio) Bridge Company was destroyed by fire. Loss, $150,000.

The National Briquetting Company, Minneapolis, Minn., will erect a plant at Kenmore, N. D.

The Atkinson Foundry and Machine Company, St. Albans, W. Va., will enlarge its plant.

The Dunn Plow Company, Wake Forest, N. C., recently organized, will establish a plant.

The Rickersburg Brass Company, Cleveland, Ohio, will erect an addition to its foundry.

The Eau Claire (Wis.) Trunk Company will build a new three-story factory to cost $12,000.

The Boerne (Tex.) Dairy Feed Company contemplate the erection of ice factory and creamery.

H. W. Kreuger will establish a cornice factory at 410 North Adams street, Green Bay, Wis.

The American Steel Foundries has drawn plans for extensive additions to its Alliance, Ohio, plant.

The Phœnix Manufacturing Company, Eau Claire, Wis., will build an addition to be used as a foundry.

The Oskaloosa (Iowa) Traction Company is contemplating the purchase of a 250-horsepower engine.

A. L. Mitchell and C. W. McFarlane, Orange, Tex., will establish a garage and gas-engine works.

The plant of the S. A. Whitney Carriage Company, Leominster, Mass., was burned. Loss, $30,000.

The Continental Motor Manufacturing Company, Muskegon, Mich., is preparing to erect a new factory.

The Hartford (Conn.) Electric Light Company will build an addition and install a new turbine engine.

The Quaker City Laundry Company, Ltd., Philadelphia, Penn., has purchased site for a new building.

The Toledo (Ohio) Iron Works, manufacturing steam shovels, will move its plant to Evansville, Ind.

Authentic news is solicited for this department. Real opportunities for the sale of machinery of any kind.

The plant of the Virginia-Carolina Chemical Company, Greenville, N. C., was partly destroyed by fire.

The McCaskey Register Company, Alliance, Ohio, is having plans prepared for two additional buildings.

The Sanders Manufacturing Company, Dalton, Ga., manufacturing pea hullers, etc., will move to Rome, Ga.

Cunningham & Co., Rochester, N. Y., are purchasing machinery for their new automobile department.

The Gilbert Improved Corrugated Culvert Company, of Austin, Minn., will erect a plant at Aberdeen, S. D.

The new factory for the Dairy Machinery and Construction Company, Derby, Conn., is nearing completion.

The Kemnick Sand and Stone Company, Ltd., Saskatoon, Sask., Canada, will erect a $60,000 brick plant.

The foundry and pattern building of the Western Stove Works Company, Peoria, Ill., was destroyed by fire.

The plant of the T. C. Richards Hardware Company, Winsted, Conn., was destroyed by fire. Loss, $125,000.

The Southern Pacific Railroad has awarded contract for the construction of a new roundhouse at Glidden, Tex.

The Warwick Iron and Steel Company, Philadelphia, Penn., will make extensive alterations to its furnaces.

The Frederick (Md.) Railroad will construct car shops and freight yards. W. S. Taylor, general manager.

The Consumers Ice and Cold Storage Company, Sacramento, Cal., will erect a new $40,000 cold-storage plant.

The Universal Machine Screw Company, Hartford, Conn., has secured site on which a new plant will be erected.

Work has been commenced on the new machine shops for the Nevada, California & Oregon Railroad, at Reno, Nev.

The plant of the New England Rendering Company, Boston, Mass., was destroyed by fire. Loss, about $700,000.

The Hobbs Manufacturing Company, London, Ont., is to build a new glassworks this spring to cost about $25,000.

The Standard Sanitary Manufacturing Company, Louisville, Ky., has taken out a permit to build a five-story factory.

The Yale & Towne Manufacturing Company, Stamford, Conn., will shortly begin the erection of a six-story addition.

The Wilhelm Telephone Manufacturing Company, Buffalo, N. Y., will establish a branch plant at Dunnville, Ont.

Contract has been awarded for the erection of a new plant for the White Sewing Machine Company, Cleveland, Ohio.

The American Stove Company, St. Louis, Mo., has acquired site on which a new plant to cost $500,000 will be erected.

Plans are being prepared for a four-story addition to the watch plant of Robert H. Ingersoll & Bro., Trenton, N. J.

The advisability of establishing a municipal lighting plant at Malden, Mass., is being considered by the finance commission.

The Northern Foundry and Machine Company, Winnipeg, Man., will build a foundry at Point Douglas, to cost $10,000.

The Philadelphia (Penn.) Roll Mill and Machine Company has had plans prepared for the erection of a $12,000 roll mill.

The plant of the Proctor Metal Manufacturing Company, Milwaukee, Wis., was burned, causing a loss of $10,000.

The Dunbar (Penn.) Furnace Company is preparing for the erection of a rolling mill. About $2,000,000 is to be expended.

Fire damaged the machine shops of the Hoefer Manufacturing Company, Freeport, Ill., to the extent of about $15,000.

The Mandt Wagon Company, Stoughton, Wis., is to erect a new forge and blacksmith shop and other buildings this summer.

H. J. Leighton, Syracuse, N. Y., is erecting a factory at 1020 West Fayette street for the manufacture of his gasolene engines.

The Farmers Grain and Live Stock Company, Oakland, Neb., will build a new grain elevator to replace one recently burned.

The Standard Saw Manufacturing Company, Louisville, Ky., has secured a permit for the erection of a five-story factory.

The Nicholls Tubing Company, of New York, has leased a building in Hoboken, N. J., and will move its factory to that place.

The Dwasco Manufacturing Company, of Holland Patent, N. Y., making plumbing supplies, will move its plant to Canandaigua.

The Gramm Motor Car Company, of Bowling Green, Ohio, is to erect a $500,000 automobile-manufacturing plant in Lima, Ohio.

The Skyland Hosiery Company will erect a building to replace the burned structure at Flat Rock, N. C. Main offices are Tyron, N. C.

The Covert Motor Vehicle Company, Lockport, N. Y., has let contract for the construction of an additional building to cost $30,000.

Maddox Foundry and Machine Company, Archer, Fla., will erect additions to its machine shop and pattern and blacksmith shops.

The Molle Typewriter Company is to build a factory at Appleton, Wis. The Merchants Association is said to be back of the project.

Doubleday, Page & Co., publishers, New York, have bought site at Garden City, L. I., on which an immense plant is to be erected.

W. Campbell Harris has had plans prepared for the erection of a garage and carpenter shop at 1536 Sansom street, Philadelphia, Penn.

The F. H. Evans Iron Works, 596 Kent avenue, Brooklyn, N. Y., is erecting a new three-story building at Hewes street and Kent avenue.

The main buildings of the New Method Stove Company, and the Baxter Stove Company, Mansfield, Ohio, were burned. Loss, $200,000.

The P. H. Hanes Knitting Company, Winston, Salem, N. C., is planning the erection of

a yarn mill at Charlotte, N. C., to cost $250,000.

The Lidgerwood Manufacturing Company, New York, is to build a plant at Lachine, Que. The company manufactures hoisting engines, etc.

The G. Heileman Brewing Company is soon to let contract for the construction of a large warehouse and cold-storage building in Minneapolis, Minn.

The Lyster Chemical Company has opened offices in the Gleason building, Lawrence, Mass., and is planning the erection of a plant in that place.

The Arizona United Mines Company, Johnston, Ariz., will shortly install pumps to raise water from the seventh level. I. Wayne Von Leer, manager.

The pattern storehouse of the Minnequa plant of the Colorado Fuel and Iron Company, Pueblo, Colo., was destroyed by fire. Loss, $1,000,000.

Plans have been completed by Arthur L. Webb, of Springfield, Mass., for the new plant for the Grip Coupling Manufacturing Company, at Ware, Mass.

The Glover-Forsyth Company, 611 Gibbs building, San Antonio, Tex., will establish a canning and preserving plant at the new town of Farmington, Tex.

The Gisholt Machine Company, Madison, Wis., is to enlarge its power house to accommodate a 500-horsepower Corliss engine, and will also enlarge its foundry.

The Seattle-Tacoma Power Company is erecting a large addition to its plant at Tacoma, Wash., which will double its capacity. About $500,000 is to be spent.

The Doehler Die Casting Company, Court street, Brooklyn, N. Y., is breaking ground for a new shop building next to the present plant that will double the output.

The ice-making plant at the Bernheimer & Schwartz brewery, on One Hundred Twenty-Ninth street, near Amsterdam avenue, New York, is to be enlarged by a two-story annex.

Construction work has been started on buildings which are to replace the machine, blacksmith and other shops at the Goldfield (Nev.) Consolidated mines, recently burned.

Plans are being drawn for the erection of a new yarn mill in Woonsocket, R. I., to be known as the Nyawza Mills. John W. Farwell, of Cohasset, Mass., is president of the company.

The plant of the John Manswell Company, Newark, N. J., was destroyed by fire, causing a loss of about $75,000. The concern manufactured pressed cork for lining cold-storage warehouses.

The American Iron Works, Penn City, Tex., recently incorporated with $50,000 capital, will establish a plant to manufacture dredge machinery, marine engines, etc. George Guild, manager.

The Carroll-Hixon-Jones Company, Milford, Mass., has awarded contract for the construction of a new boiler house. Plans are being prepared for several additions. The company manufactures straw goods.

The American Rolling Mill Company, of Middletown, Ohio, has decided on the following additions: Four 65-ton open-hearth furnaces, a 40-inch blooming mill, two jobbing mills, four cold-rolling mills.

It is reported the General Electric Company, Schenectady, N. Y., is preparing to build a plant at Erie, Penn., on a tract of land purchased some time ago. It is said the plans call for 58 buildings.

Bids will be opened March 10, by the Fire and Water Board, Kansas City, Mo., for a number of machine tools, including lathes, planer, shaper, milling machine, radial drill, hack saw, grinder, blower. Particulars can be had of S. J. Armstrong, secretary.

The Gas Engineering Company, Trenton, N. J., which has been formed to take over the business of Frank D. Moses, will be in the market for iron-working machinery, including plate rolls, horizontal punches, bulldozers, also lathes, drills, boring mills, etc.

The Stratton & Bragg Company, Petersburg, Va., is building a modern shop for the manufacture of engines and sawmill machinery. Also contemplate the construction of a brass foundry and the addition of a structural steel and sheet-metal department. Punches, bending rolls, etc., will be needed.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open the following bids: March 15—Belt-driven engine lathe (schedule 2281); March 22—Hard sheet brass, hot-rolled sheet copper (schedule 2279); March 29—Motor-driven bench drills, cold-metal sawing machine, boring and turning mills (schedule 2283).

The John B. Morris Machine Tool Company has been incorporated and has purchased the machine-tool business of the John B. Morris Foundry Company. Plans are now being prepared for a new factory building with a floor of over 30,000 square feet, to be used in the manufacture of machine tools, formerly made by the John B. Morris Foundry Company. Additional equipment will be installed and the company expects to increase its lines.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open the following bids: March 8—Leather belting (schedule 2282), pulleys, turned-steel shafting (schedule 2272), frogs No. 3, wing rails, straight, angle bar joints, steel rails, 60-pound A. S. C. E. section, switch points, ties (schedule 2270), bolts, nuts, washers, twist drills, brass wood screws (schedule 2282), steam traps (schedule 2275), flexible copper tubing, brass pipe (schedule 2275), valves (schedule 2282).

NEW INCORPORATIONS

Noriz Manufacturing Company, Kittery, Me. Locks, keys, safes, etc. Capital, $500,000. H. Mitchell, president.

National Clinch Hinge Company, Chicago, Ill. Manufacture metal specialties. Capital, $50,000. Incorporators, H. C. Baker, N. Selegue, L. M. Higgins.

Vinot Automobile Company, New York. Manufacture motors, engines, automobiles, etc. Capital, $37,500. Incorporators, H. S. Lake, A. H. Peyser, S. Kjeldsen.

Commercial Car Company, Indianapolis, Ind. Manufacture automobiles. Capital, $100,000. Incorporators, I. B. Buckley, Harvey T. Huff, Edmund B. Walker.

Keith Car and Manufacturing Company, Portland, Me. Manufacture railway cars, etc. Capital, $2,000,000. James F. Bacon, Boston, Mass., president and treasurer.

The Vincennes Motor Manufacturing Company, Vincennes, Ind. Manufacture gasolene motors and motor vehicles. Incorporators, W. T. Havill, M. E. Hunter, C. H. Huston.

Davis Foundry Company, Edgewater, N. J. General foundry and machine business. Capital, $25,000. Incorporators, C. E. Davis, H. W. Davis, W. J. Allen, North Bergen.

Atlas Chain Company, New York. Manufacture anti-skid chains and automobile appliances. Capital, $350,000. Incorporators, G. E. Holmes, D. Milliken, K. K. McLaren.

Manhattan High Power Marine Company, New York. Manufacture motors, motor boats and supplies. Capital, $300,000. Incorporators, J. Treen, W. F. Reeves, C. C. Voorhees.

Seymour Metal Goods Company, Seymour, Conn. Manufacture copper, brass and metals of all kinds. Capital, $100,000. Incorporators, G. H. Weaver, C. S. Boles, F. A. Rugg.

Roger Raymond Manufacturing Company, Mystic, Conn. Manufacture wrenches and hardware specialties. Incorporators, Wm. H. Dennis, E. B. Seamans, Capt. M. L. Gilbert.

Michigan Motor Truck Company, Lansing, Mich. Capital, $1,000,000. Motor trucks and road vehicles. Stockholders, Herbert M. Thomas, James C. Brown, Frank C. Staubin, etc.

Weinberg Paper Company, New York. Manufacture paper, paper board, paper boxes, etc. Capital, $25,000. Incorporators, J. H. Berger, New York; C. S. Bloch, J. Nordenschild, Brooklyn.

The Penn Yan Flexible Conduit Company, Penn Yan, N. Y. Manufacture electrical conduits and appliances. Capital, $50,000. Directors, E. R. Ramsey, J. S. Wheeler, W. T. Morris, etc.

Vetter Auto Top Company, New York. Manufacture auto tops and automobile appliances. Capital, $10,000. Incorporators, Wm. Vetter, 249 West Sixty-Fourth street; F. E. Stoll, 530 West Twenfth street, etc.

Malden Manufacturing Company, New York. Manufacture machinery, tools, metal novelties. Capital, $30,000. Incorporators, J. C. Kopf, Brooklyn; M. Finkelstein, Ozone Park, L. I.; D. C. Sperry, New York.

Wyoming Cold Storage and Ice Company, Wyoming, Del. Manufacture ice and conduct cold-storage plant. Capital, $100,000. Incorporators, Wm. T. Carter, Jr., Wyoming, P. Emerson, F. C. Bancroft, Camden, etc.

Silent Motor Car Company, Pittsburg, Penn. Manufacture automobiles and parts. Capital, $300,000. Incorporators, Julius Sturtevant, New Kensington, Penn.; John Walsch, Beaver Falls, Penn.; Carl C. Conkle, Pittsburg, etc.

Boyd Steel Springs Company, New York. Manufacture steel springs, automobile and machine parts. Capital, $10,000. Incorporators, Henry B. Boyd, Chas. A. Cook, 505 State street, Brooklyn, A. R. Boyd, 128 Broadway, New York.

TRADE CATALOGS

E. G. Smith Company, Columbia, Penn. Folder containing testimonials regarding Columbia calipers.

Goldschmidt Thermit Company, 90 West street. Bulletin describing the repair of steel and iron rolls. Illustrated.

Chicago Machine Tool Company, Chicago, Ill. Circulars illustrating and describing Chicago (duplex) hand millers.

Western Machine Tool Works, Holland, Mich. Circulars illustrating and describing 3½- and 3-foot radial drills.

Terry Core Drill Company, 50 Church street, New York. Catalog. Core drills. Illustrated, 60 pages, 6x9 inches.

The Pilliod Lumber Company, Swanton, Ohio. Catalog describing portable tool cases. Illustrated, 12 pages, 3½x6 inches.

The Denver Engineering Works Company, Denver, Colo. Bulletin No. 1044. Electric hoists. Illustrated, 44 pages, 8½x10½ inches.

The Goheen Manufacturing Company, Canton, Ohio. Catalog. Carbonizing coating for iron and steel. Illustrated, 8x10 inches.

Mulconroy Company, 722 Arch street, Philadelphia, Penn. Catalog No. 20. 7-League rubber boots. Illustrated, 8 pages, 3½x6 inches.

The Gallgher Machinery Company, Salt Lake City, Utah. Bulletin No. 500. Callow traveling belt screen. Illustrated, 22 pages, 8½x10½ inches.

J. G. Blount Company, Everett, Mass. Catalog No. 13, describing grinding and polishing machinery, speed lathes. Illustrated, 48 pages, 6x9 inches, paper.

Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y. Booklet No. 201. Inter-communicating telephones. Illustrated, 20 pages, 3½x6 inches.

Manufacturing Equipment and Engineering Company, Boston, Mass. Catalog describing all-metal equipment for factories, foundries, etc. Illustrated, 32 pages, 6x9 inches, paper.

Ad. Bleichert & Co., Leipzig-Gohlis, Germany. Catalog. Automatic telphers. Illustrated, 86 pages, 9x12 inches. Catalog. Wire ropeways. Illustrated, 96 pages, 9x12 inches.

BUSINESS ITEMS

D. A. Hinman & Co., Sandwich, Ill., has succeeded to the business of Estep & Dolan, manufacturers of bending tools. Mr. Hinman has been connected with Estep & Dolan for nine years.

The John B. Morris Machine Tool Company has been incorporated under the laws of the State of Ohio, with a capital stock of $125,000, and has purchased the machine-tool business formerly conducted by the John B. Morris Foundry Company. Plans are now being prepared for a new factory building with floor space over 30,000 square feet.

FORTHCOMING MEETINGS

Southern Supply and Machinery Dealers' Association and American Supply and Machinery Manufacturers' Association, joint convention, Jacksonville, Fla., April 5, 6 and 7, 1910, Hotel Seminole. F. D. Mitchell, secretary, 309 Broadway, New York City.

National Metal Trades Association, annual convention, Hotel Astor, New York City, April 13-14, 1910. Robert Wuest, Commissioner, New England building, Cleveland, Ohio.

International Railway General Foremen's Association, annual convention, May 3-7, Grand hotel, Cincinnati, Ohio. L. H. Bryan, secretary, Two Harbors, Minn.

American Society of Mechanical Engineers, spring meetings, Atlantic City, N. J., May 31-June 3. Calvin W. Rice, secretary, 29 West Thirty-ninth street, New York City.

American Foundrymen's Association and American Brass Founders Association; joint convention, June 7-8-9, Detroit, Mich.; headquarters, Hotel Pontchartrain. Richard Moldenke, secretary, Watchung, N. J.

National Gas and Gasolene Engine Trades Association. Semi-annual convention, Cincinnati, Ohio, June 13-16, 1910; headquarters, Hotel Sinton. Albert Stritmatter, secretary, Cincinnati, Ohio.

Master Car Builders Association; annual meeting June 15-17, Atlantic City, N. J. J. W. Taylor, secretary, Old Colony building, Chicago, Ill.

American Railway Master Mechanics Association, June 20-22, Atlantic City, N. J. J. W. Taylor, secretary, Old Colony building, Chicago, Ill.

Joint meeting of American Society of Mechanical Engineers and Institution of Mechanical Engineers, Birmingham, England, July 26-29, 1910.

American Society of Mechanical Engineers; monthly meeting first Tuesday. Calvin W. Rice, secretary, 29 West Thirty-ninth street, New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's hotel. D. F. P. Clark, secretary, 309 Milk street, Boston, Mass.

Providence Association of Mechanical Engineers. Monthly meeting fourth Tuesday each month. E. C. Bliss, president, 91 Sabine street, Providence, R. I.

New England Foundrymen's Association; regular meeting second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania; monthly meeting third Tuesday. Elmer K. Hiles, secretary, Fulton building, Pittsburg, Penn.

Superintendents' and Foremen's Club of Cleveland; monthly meeting third Saturday. Phil. Frankel, secretary, 310 New England building, Cleveland, O.

Western Society of Engineers, Chicago, Ill. Regular meeting first Wednesday evening of each month, excepting July and August. Secretary, J. H. Warder, 1735 Monadnock block, Chicago, Ill.

WANT ADVERTISEMENTS

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendations or other papers of value should not be inclosed to unknown correspondents. Only bona-fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Experienced jig and gage designers wanted; steady employment promised. Box 245, AM. M.

Wanted—An A-1 barrel borer experienced and competent to handle a department turning out high grade rifles; must know how to get immense output at minimum costs. Box 277, AMERICAN MACHINIST.

Wanted—Foreman of department in a large New England machine shop; must be a specialist in building machinery by modern methods; this department builds one type of machine only and the acceptable man must be competent to attain maximum results; shop equipment is first class and position permanent to right man; accepted applicant will be required to show his fitness by his past record and replies will be treated confidentially. State salary expected. Box 185, AMERICAN MACHINIST.

ILLINOIS

Wanted—General foreman for hardware specialty factory; must be experienced in general machine work, grinding, assembling, etc.; must be able to systematize and produce results; state age, salary wanted, etc. "Specialty." AMERICAN MACHINIST.

Wanted—Foreman for blacksmith shop, manufacturing implements; must be sober and capable man and a hustler who can produce results with our present equipment; give references and state salary expected in first letter. Box 211, AMERICAN MACHINIST.

A growing concern in the Middle West, building automobile and motorcycle engines, want a time study man who is also an analyst and rate setter; preference will be given to man having knowledge of planning department, speed and gang boss, moving of work, tool delivery, etc. Box 268, AM. MACH.

INDIANA

Wanted—Foreman, one who has had experience in building machine tools; a bright future for the right man. Box 146, AM. MA.

Wanted—Machinists, we are continually increasing our force; we invite applications from lathe and floor hands, those who desire a steady position. Apply at Wood Turret Machine Co., Brazil, Ind.

MASSACHUSETTS

Wanted—A draftsman competent to work up layouts from rough sketches; must be accurate in detail. Reply giving experience in full and wages expected. Box 275, AM. MA.

Wanted—Operator for Brown & Sharpe and Pratt & Whitney automatic screw machines; good pay and steady employment to the right man; preference given to man able to do camming. Box 226, AMERICAN MACHINIST.

First-class mechanical draftsman and designer, preferably with high-speed steam engine experience, wanted for permanent position in large manufacturing concern in Massachusetts; state age, education, experience and salary expected, by addressing "M. W. A.," Box 243, AMERICAN MACHINIST.

Wanted—Small, well established manufactory wants a competent mechanical man to take charge as superintendent; to one familiar with automatic screw machines, foot and power presses, also second operation work and with some experience in tool making, this is an exceptional opportunity; state age, experience and salary. Box 225, AM. MA.

Wanted—An energetic young man, technical education preferred, to introduce a special brand of steel for machine tool parts in New England territory; permanent position at good salary; applicant should have good general knowledge of qualities required in various machine tool parts; no application considered except from parties of highest standard of character and ability; all applications treated in strictest confidence. Address with full particulars, P. O. Box 1188, Boston, Mass.

We are increasing our force and invite applications from experienced iron and brass moulders, core makers, chippers, pattern makers, draftsmen, production men, machine tool operators (all kinds), brass finishers, polishers, layout men, bench hands, erectors, etc. Heavy and light engine and pump manufacture; works handy to Boston and best evening schools; no labor trouble, and applicants are notified as soon as positions are open; applicants should state age, height, weight and experience in detail. Address Employment Division, Blake & Knowles Steam Pump Works, East Cambridge, Mass.

MICHIGAN

Wanted—Experienced gunbarrel and gun frame bluer. Please state experience, rate of wages expected, etc. Box 3, AMER. MACH.

Wanted—Toolmakers, die sinkers, lathe hands, machinists and automatic screw machine operators; A-1 men only. Buick Motor Co., Flint, Mich.

Gasolene engine factory in southern Michigan requires more toolmakers, patternmakers and draftsmen on engine and tool and fixture work; applications from first-class men should state age, experience and wages required. Holms Machine Mfg. Co., Sparta, Mich.

MISSOURI

Foreman Wanted—An experienced man capable of taking charge of 100 men who thoroughly understands the manufacture of woodworking machinery. Address giving experience, nationality, age, reference and salary. Box 298, AMERICAN MACHINIST.

NEBRASKA

Wanted—In city of Middle West, first-class machinist to operate upright style of mill roll corrugating machine; must have had experience in this class of work and be familiar with the milling industry. Box 254, AM. MA.

NEW JERSEY

Man to take charge of tool room; state experience and wages expected. Ferracute Machine Company, Bridgeton, New Jersey.

Wanted—Draftsmen familiar with machine tool work; give references and salary expected. Box 215, AMERICAN MACHINIST.

Wanted—Draftsmen familiar with heavy turret lathe work; give references and salary expected. Box 216, AMERICAN MACHINIST.

NEW YORK

Wanted—First-class jig and fixture draftsman. Apply Mergenthaler Linotype Company, 24 Ryerson St., Brooklyn, N. Y.

Wanted—Mill draftsman, preferably with some structural experience. I. E. Blumgardt, Maxwell-Briscoe Motor Co., Tarrytown, N. Y.

Wanted—Expert toolmakers on punches and dies; good wages and superior shop. Apply Bates Machine Co., 704 Jamaica Ave., Brooklyn, N. Y.

Wanted—First-class toolmakers, experienced on jig, fixture, watch tool and precision work. Apply Mergenthaler Linotype Co., 24 Ryerson St., Brooklyn, N. Y.

Wanted—First-class tool and diemakers on accurate work; best wages to steady men. Precision Manufacturing Co., 402 So. Franklin St., Syracuse, N. Y.

Wanted—A young man who is a practical machinist, understanding checking of drawings and stock sheets; wages $18 per week. Box 258, AMERICAN MACHINIST.

Wanted—First-class automatic screw machine hands; none but experienced parties need apply. Mergenthaler Linotype Company, 20 Ryerson St., Brooklyn, N. Y.

Draftsmen and toolmakers wanted, experienced on tool, jig and fixture work; state age, experience in detail and rate expected. Remington Arms Company, Ilion, N. Y.

Wanted—Young man with general knowledge iron and steel jobbing business; must understand stenography; good opportunity for right party. Box 257, AMERICAN MACHINIST.

Wanted—Foundry foreman, experienced in gray iron bench work and machine molding on agricultural work; state age, previous experience and salary expected; give references. Address "L. D.," AMERICAN MACHINIST.

Wanted—Master mechanic, capable of taking charge of jig and die designing, millwrighting, and general plant repair work; state age, previous experience and salary desired; give references. Address "F. R.," AM. M.

A Central Tool Dressing Plant in a Navy Yard

Supplying Tools for Several Yards on the Atlantic Coast

By W. H. Taylor

Since the advent of high-speed steel there has been a disposition on the part of a few progressive corporations, operating a number of machine shops, toward the establishment of a central plant for dressing, treating and grinding high-speed lathe, planer and other tools. This tendency has been founded on the belief that such a plant would effect great economies in shop operation, due to placing on a strictly manufacturing basis, the forging, treating and grinding of tools, and to the furnishing of all shops with tools of standard shapes and of uniformly high quality. But prior to November, 1908, no scheme worthy of commercial consideration had been perfected and put into successful operation. It therefore remained for the United States Navy Department to carry out the first successful installation and operation of a central plant for the manufacture of high-speed lathe, planer and other tools.

Through the courtesy of the Secretary of the Navy I am permitted to give the specifications and to describe the details and point out the savings that may be effected by the establishment of a central tool-dressing plant, and which should prove of interest to large commercial concerns and railroads, operating a number of machine shops, many of whom are working along the same general lines toward centralization and standardization.

Many who read this article will question the advisability of standardizing all tools, thinking it undesirable because it restricts each workman from developing his individuality by choosing the particular implements and methods which suit him best. They ignore the fact that in ninety-nine cases out of a hundred, where a workman chooses his own methods and implements, he is not held in any strict sense accountable for the quality of his work. When one recognizes that the cutting speed of the best-treated high-speed steel tool is materially decreased by improperly shaping the cutting edge, then the fact must be recognized that there is economy to be gained through the adoption of uniform standards.

The common method of purchasing tool steel, as practiced by the majority of manufacturing plants, affords no reliable means of determining whether any particular brand of steel measures up to the requirements, and as a result a heavy productive cost is imposed upon the machine shop by tools made from a batch of inferior steel, not only owing to the fact that tools made from this particular batch of steel cannot stand up under high cutting speeds, but the influence of their inferiority lowers the standards of high-grade tools. This irregularity in the dependableness of tools necessitates a lower *average* speed, favorable to the inferior tool, so as to insure a continuous

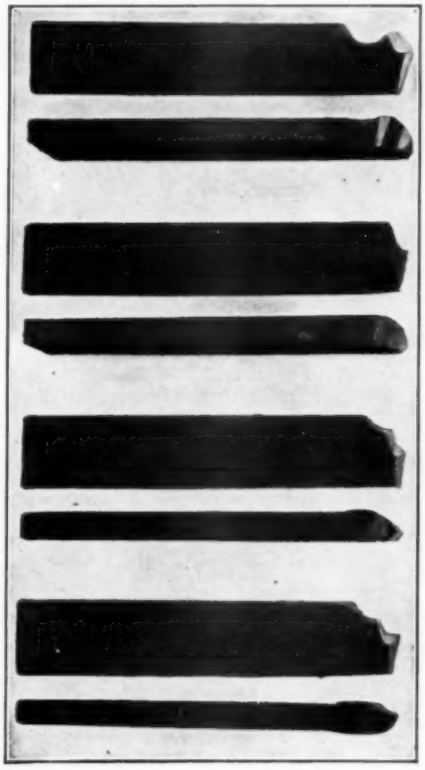


FIG. 1. TOOLS ACTUALLY FOUND IN USE

FIG. 2. STANDARD ROUGHING TOOL

operation of all tools in the batch, with a resultant loss in machine production which may become very high.

It is therefore one of the most important elements in the management of a machine shop, and one which so few managers recognize as a dividend-paying investment, to insure the provision of an adequate supply of suitable tools properly forged, treated and ground, and stores, ready for use, in a tool room. Frequently a workman will use undesirable tools because he cannot procure suitable ones, or because he has not the opportunity nor inclination to keep his tools in repair. Many workmen realize the importance of securing a plentiful supply of tools, in which case they seize and hoard every desirable tool on which they can lay their hands, which necessitates investing in a larger quantity of tool steel than is responsible for the quantity and quality of tools.

Usually the adoption of standard shapes for lathe and planer tools, and grinding them to prescribed shapes in a grinding department will meet with considerable opposition, the most frequent objection being "each machinist prefers to grind his tools to suit himself," the result being that for any one given purpose each of the several machinists will grind his tools differently, as exemplified in Figs. 1 and 2. This opposition on the part of the workmen was not met with, to any marked degree, in any of the navy yards.

It is remarkable that the importance of uniformity in the quality of high-speed steel tools supplied to workmen has not been more fully appreciated, and that hardly a shop can be found, including those otherwise progressive and well equipped, in which the tools made from several different brands of high-speed steel are not used side by side, and in the majority of cases with positively no means employed to identify one from another.

The Navy Department at one time considered it necessary in each purchase of tool steel to mention one or more proprietary brands as being the only ones that would meet the requirements of the work which the steel was intended to perform. This eliminated competition and while the steel used proved satisfactory to the yards, certain firms protested vigorously against being excluded from a share of the business.

To obviate contention from this source the department decided that competition should be introduced into the purchase of tool steel and the specification published in the AMERICAN MACHINIST at page 187, Volume 32, Part 2, resulted.

The board, from observations made in various industrial plants and from consultations with its expert collaborators, recognized the desirable effects that uniform standards have upon production; that many abuses, in this connection, are

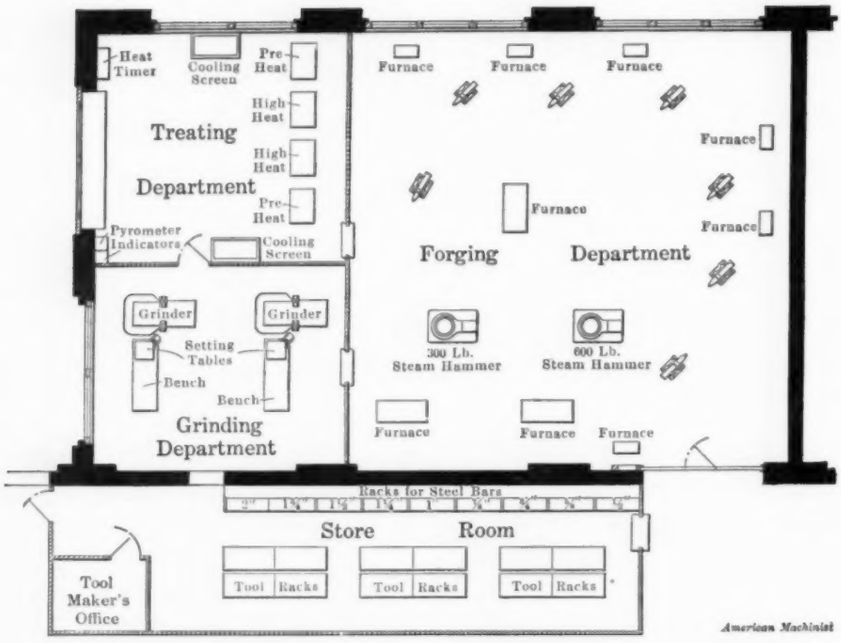


FIG. 3. PLAN OF THE FORGE SHOP

CENTRAL TOOL DRESSING PLANT

After adopting standard chemical and physical specifications for high-speed steel best suited to all classes of work, insuring uniformity and low prices as a result of competitive bidding by steel makers, the Navy Department authorized the employing of experts to collaborate with the board and the officers in charge of the yard selected, in the establishment of a central tool-dressing plant, standards for forging, treating and grinding tools and methods of heat treatment. The Tabor Manufacturing Company, of Philadelphia, Penn., were retained and the plant was installed under the direction of H. K. Hathaway.

This plant has a capacity of 800 tools per day and consists of a forge shop, treating department, grinding department, store room and a department of chemical and physical test, all of which will be described in the order given, together with the apparatus necessary for producing standard tools of the highest quality at a minimum cost. Tools are made practised; that few shop managers have given much consideration to this all-important element which has so vital a bearing on the output of machine tools.

As a result of its investigations, and contrary to the overwhelming consensus of opinion objecting to purchasing tool steel under specification, the board was convinced of the desirability of these specifications, sufficiently exact to permit of the purchase of tool steel after competition, and to insure the receipt of tool steel that would respond to uniform methods of treatment to be specified in each case. This feature was regarded by the board as most important, as diversity of methods of treatment was the ground upon which the yards justly based their objections to using promiscuously the various brands of tool steel.

The board coupled with its report on specifications for high-speed steel, a recommendation relative to the establishment of a central tool-dressing and grinding plant to manufacture high-speed lathe and planer tools, and also a department for making physical tests required by the specifications, League Island, Philadelphia, Penn., being chosen as the most central location, and offering the best facilities for transportation by rail and water to the Atlantic Coast Navy Yards.

The board decided that it would be difficult, as well as expensive, to equip each yard with the necessary apparatus required for the production of standard tools and to maintain the standards established throughout the yards, while it would be comparatively a simple matter to accomplish this in one plant, where the entire energy was concentrated on the dressing, treating and grinding of standard tools and testing of high-speed steel.

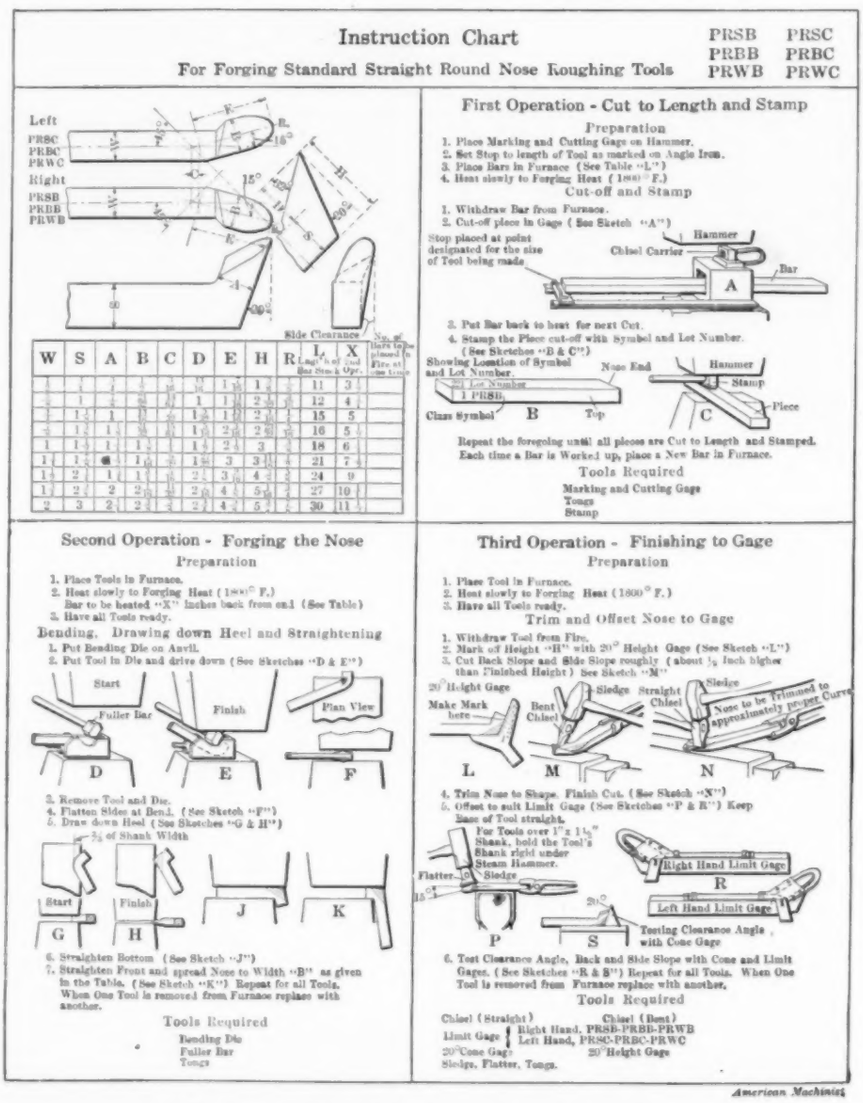

Instruction Chart
For Forging Standard Straight Round Nose Roughing Tools
PRSB PRSC
PRBB PRBC
PRWB PRWC
Left
PRSC
PRBC
PRWC
Right
PRSB
PRBB
PRWB
Side Clearance
W S A B C D E H R L X
First Operation - Cut to Length and Stamp
Preparation
1. Place Marking and Cutting Gage on Hammer.
2. Set Stop to length of Tool as marked on Angle Iron.
3. Place Bars in Furnace (See Table "L")
4. Heat slowly to Forging Heat (1800° F.)
Cut-off and Stamp
1. Withdraw Bar from Furnace.
2. Cut-off piece in Gage (See Sketch "A")
Stop placed at point designated for the size of Tool being made
Hammer
Chisel Carrier
Bar
A
3. Put Bar back to heat for next Cut.
4. Stamp the Piece cut-off with Symbol and Lot Number.
(See Sketches "B & C")
Showing Location of Symbol and Lot Number
Nose End
Hammer
Stamp
Piece
Class Symbol
Top
B
C
Repeat the foregoing until all pieces are Cut to Length and Stamped.
Each time a Bar is Worked up, place a New Bar in Furnace.
Tools Required
Marking and Cutting Gage
Tongs
Stamp
Second Operation - Forging the Nose
Preparation
1. Place Tools in Furnace.
2. Heat slowly to Forging Heat (1800° F.)
Bar to be heated "X" inches back from end (See Table)
3. Have all Tools ready.
Bending, Drawing down Heel and Straightening
1. Put Bending Die on Anvil.
2. Put Tool in Die and drive down (See Sketches "D & E")
Start
Fuller Bar
Finish
Plan View
D
E
F
3. Remove Tool and Die.
4. Flatten Sides at Bend. (See Sketch "F")
5. Draw down Heel (See Sketches "G & H")
⅔ of Shank Width
Start
Finish
G
H
J
K
6. Straighten Bottom (See Sketch "J")
7. Straighten Front and spread Nose to Width "B" as given in the Table. (See Sketch "K") Repeat for all Tools.
When One Tool is removed from Furnace replace with another.
Tools Required
Bending Die
Fuller Bar
Tongs
Third Operation - Finishing to Gage
Preparation
1. Place Tool in Furnace.
2. Heat slowly to Forging Heat (1800° F.)
3. Have all Tools ready.
Trim and Offset Nose to Gage
1. Withdraw Tool from Fire.
2. Mark off Height "H" with 20° Height Gage (See Sketch "L")
3. Cut Back Slope and Side Slope roughly (about ¼ Inch higher than Finished Height) See Sketch "M"
20° Height Gage
Make Mark here
Sledge
Bent Chisel
Straight Chisel
Sledge
Nose to be Trimmed to approximately proper Curve
L
M
N
4. Trim Nose to Shape. Finish Cut. (See Sketch "X")
5. Offset to suit Limit Gage (See Sketches "P & R") Keep Base of Tool straight.
For Tools over 1" x 1½" Shank, hold the Tool's Shank rigid under Steam Hammer.
Flatter
Sledge
Right Hand Limit Gage
R
Left Hand Limit Gage
P
S
Testing Clearance Angle with Cone Gage
6. Test Clearance Angle, Back and Side Slope with Cone and Limit Gages. (See Sketches "R & S") Repeat for all Tools. When One Tool is removed from Furnace replace with another.
Tools Required
Chisel (Straight)
Chisel (Bent)
Limit Gage { Right Hand, PRSB-PRBB-PRWB / Left Hand, PRSC-PRBC-PRWC
20° Cone Gage
20° Height Gage
Sledge, Flatter, Tongs.
American Machinist

FIG. 4. INSTRUCTION CHART FOR BLACKSMITH

up in such quantities as to insure economical manufacture and carried in stock, from which the requirements of the various yards are supplied. The tools thus furnished are used until they require redressing, when they are to be returned to the central plant and replaced with newly dressed tools from stock.

All tools receive their initial grinding at the central plant, and subsequent grinding is done at the respective yards.

Tools returned for redressing are held in stores until a suitable sized lot has accumulated, when an order is entered to forge, treat and grind them. Tools worn down so as to be too short for further dressing are drawn down to smaller sizes.

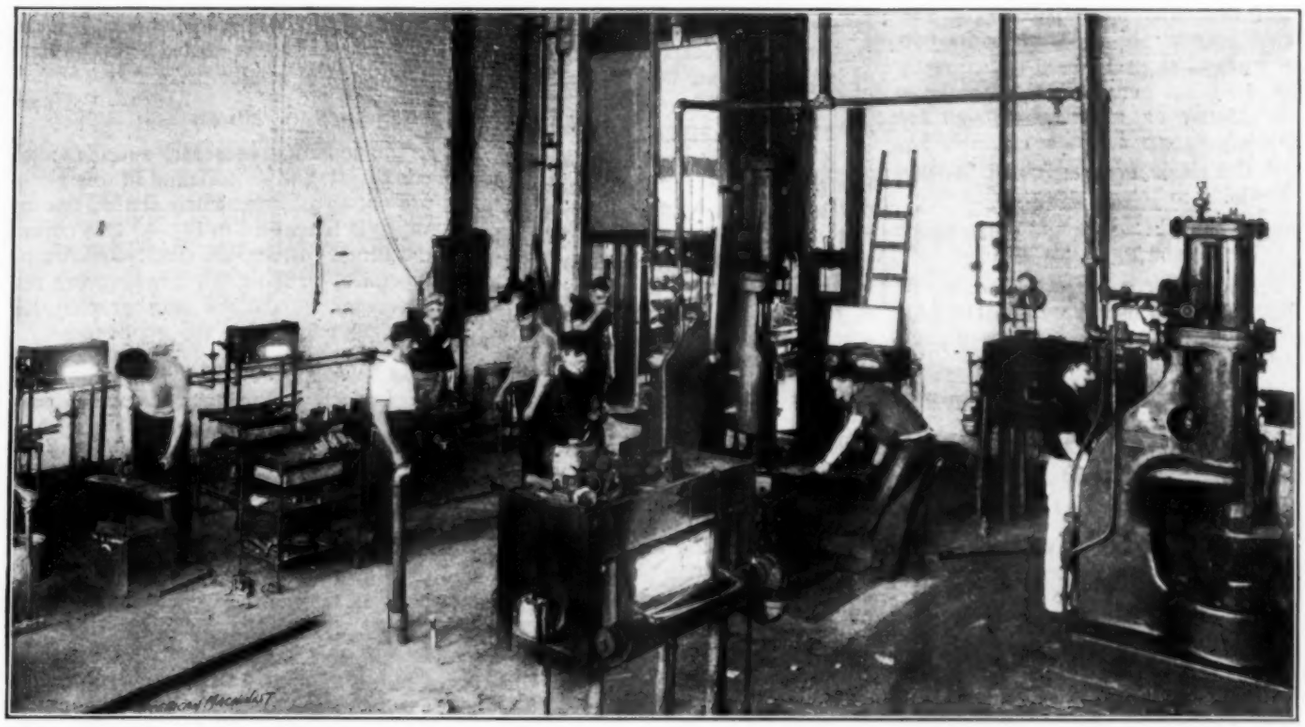


FIG. 5. GENERAL VIEW OF FORGE SHOP

FORGE SHOP

The forge shop is equipped to handle bars up to 2 inches wide and 3 inches deep, having one 600- and one 300-pound steam hammer and anvils for eight smiths; both the steam hammers and anvils are fed by oil furnaces. Then there are the necessary bending dies, gages, templets, chisels, hammers and sledges. The plan and general view of this shop is shown in Figs. 3 and 5.

With the equipment in the navy yards, which was similar to the average smith shop, the forging of high-speed steel tools was not only difficult, but it was slow and wasteful of steel. With the proper appliances, such as steam hammers, bending dies, gages and instruction charts it became a simple matter to produce tools economically, both as to time and material, and of a uniform shape which required a minimum amount of grinding.

Consideration was first given to the fuel. Exhaustive experiments were made in the Navy Yard and elsewhere with soft coal, coke, gas and oil; while the two latter proved equally satisfactory, oil was selected owing to the location of the plant and to the expenditure involved in furnishing a supply of gas. Oil as a fuel has proved, since the plant has been in operation, more satisfactory than soft coal or coke, avoiding the difficulties heretofore encountered in heating tool steel in forge fires burning coal or coke. It is more economical for the work performed; saves time in making up fire; occupies less space; is clean, free from soot, smoke, dirt and ashes; the supply of fuel can be regulated to give and maintain the desired temperature; requires less skill on the part of smith or helper.

HEATING

Rules, governing the heating of high-speed steel bars preparatory to cutting off and the heat required for forging the steel, were formulated, and as they best describe the procedure and point out the causes of failure, they are given herewith:

"In forging high-speed steel care must be used not to heat it too rapidly nor to work it too cold; 1800 to 1900 degrees Fahrenheit is the temperature at which best results will be obtained. This corresponds to a yellow heat. High-speed steel should be heated slowly and evenly, and it is well, while some tools are being heated to a forging heat, to have others placed on the hearth being preheated. Tools should not be left in the furnace for more than a minute or two after reaching the forging heat, as the steel is injured to some extent if it is allowed to "soak" and is held for any length of time at temperatures above 1500 degrees.

"The smith or heater should keep several tools going at one time, so that he will always have a tool ready to work on when one tool is finished, or cools so that it must be reheated. *Do not attempt to work a tool after it cools below a cherry red* (about 1500 degrees), as below this heat high-speed steel does not work readily and there is danger of its breaking or developing cracks, if any heavy work is done on it.

"The furnace should be regulated so that it will not give over 1800 to 1900 degrees. In working a tool, when it cools to a cherry red put it back in the furnace and take another that is heated up to the forging point. Keep from four to six tools heating at a time, and whenever one tool is finished place another in the fire and another on the hearth to preheat.

CUTTING OFF

In cutting off high-speed steel it should always be nicked on all four sides while hot. Unless this is done there is danger of the bar splitting at the ends when broken. For this purpose it is not necessary to heat it beyond 1400 to 1500 de-

grees, or a dull cherry red. The tools should also be stamped at this heat."

The following paragraphs are quoted from F. W. Taylor's paper "On the Art of Cutting Metals" and have a vital bearing on the working of high speed steel.

"The tool should be carefully straightened on the anvil so as to have as nearly as possible a true bearing upon its bottom surface. This bearing should extend all the way from the front to at least half-way back on the tool. A surface plate should be provided close to the blacksmith's anvil for testing the accuracy of this operation. The importance of having this bottom surface true is not ordinarily appreciated. The tool should bear at all points along its bottom surface, at its forward end, directly underneath the cutting edge, in order to avoid chatter or breaking through too much overhang; and also directly beneath the clamp to avoid either bending or breaking at this point.

Fire or Heat Cracks in Tools Come from Four Principal Causes

"Seams or internal cracks in the bar of tool steel caused mainly by imperfections in the ingot or by too rapid or uneven heating in hammering the bar.

"Blacksmiths are prone to attribute all cracks in their tools to the maker of the tool steel. It is our observation, however, that nine-tenths of the cracks in tools are due to bad treatment in the smith shop rather than to imperfections in the bar.

"The second cause for cracking is breaking the bar while cold. The third is heating the bar unevenly by keeping it in the same position in the fire throughout the time of heating. The portion of the tool next to the fire expands more rapidly than the steel directly above it, and actually tears the colder metal apart.

"The fourth cause for cracks is too rapid heating in an intense fire. Even if properly turned over and over the outside portions of a tool (particularly if it be of large body) are heated to a high forging heat before the center of the section has reached its proper temperature.

"If hammered when in this condition, internal cracks in the tool are likely to be developed, because the center of the bar, instead of being malleable as the outside is, still remains comparatively cold and brittle, and the steel being unable to flow is torn apart, thus producing internal cracks. Internal cracks are also caused in some cases by hammering the outside of the bar with too light taps of the hammer. The force of the hammer blow should be powerful enough to penetrate to the center of the bar and should, therefore, increase with the size of the steel.

"It is from the third and fourth causes that cracks are most frequently developed and therefore, slow heating and frequent turning of the bar in the fire are to be recommended, particularly during the early stages of heating. If the heat must be hurried, let it be during the final rise in temperature from the cherry red, say, up to the proper forging heat.

"The above remarks refer to high-speed tools of course, not to either tempered tools or the old self-hardening tools, which should not be heated beyond a light cherry red in forging."

Forging

The apparatus necessary and the methods of using it, as followed in this plant, are shown on instruction charts, one of which is illustrated in Fig. 4. This covers the forging of straight round-nose roughing tools, right or left hand, giving the necessary dimensions and graphic instructions for using the appliances.

(To be Continued)

Building a Shop From Its Earnings

By Con Wise

I have been wondering whether or not it pays to save money. When a man is in business or on a salary it counts up enough to notice, but for a man on day wages to begin to save up his spare change to get rich is such a hopeless task.

The difference between investing a few dollars a month, or year, at savings bank rates and at 10 per cent. is something astonishing. Suppose you lay away just one dollar a year in the bank at 4 per cent. and Jim puts the same somewhere, where it draws 10 per cent. The first few years the difference is not great but at the end of 25 years Jim will have about $132 and all you can count up will be in the neighborhood of $44.

The only hitch in the program is that Jim is almost sure to lose all of his before the 25 years rolls around. More than that; 10 per cent. investments that pay 10 per cent. in cash are scarce.

I am reminded of all this because I ran across an old friend of mine who has accumulated a good bit of money without doing anything so very startling.

He got the "going into business" bee in his bonnet some 20 years ago, but instead of doing as most men do and chucking his job, he went out and hired a little shop and then he hired a man to run it. He did his bookkeeping and sold his goods in the evenings. The shop grew from one man to a man and a boy and then one man after another was added until when he had some fifty men working he threw up his salaried position and went out to his own works. When he got there he found that his previous necessity had compelled him to have so good an organization that his own presence was almost needless.

Savings and Earnings Put into the Business

While he was building up the shop he put into it every cent that he could save from his salary, and all that the shop made, he put back into it. He made something like 10 per cent. on the money invested. He could also control his investment himself, within human limitations, which was very different from putting his money in other men's hands. When you buy stock in a concern that you do not control it is just the same as lending it without even taking a note in return. You simply have the privilege of hoping for dividends. If the controlling interest prefers to put the surplus money back into the business or pay it all out in salaries you are helpless. If you own your own plant you may not have large hopes but you may get more.

The man mentioned before did another clever thing. When he started the shop it took all his money for the first month's wages of his man and the rent, after buying the most necessary equipment. He kept his one man going on work by the hour for other people who furnished their own materials. He got his pay almost as fast as the work was done, and in that way he kept things moving. As he was able to save from his own salary and a little margin of profit began to appear from this outside work, he put it into his own specialty but he really made his shop build itself up.

Enforced Economical Drawings

He was, of course, his own draftsman and designer, which meant that the drawings were rather few. Yet they had to be complete and accurate because he could not be there in person, to explain discrepancies. It paid him to make them accurate, and the fact that his time was limited so that he made as few as possible, I believe was in his favor. You can hardly make drawings without dimensioning them, and there is no generally accepted way of indicating to a machinist that all a certain piece fits into is the surrounding air and all that is required is that it shall run true and not shake the machine to pieces. If there is no drawing, you can simply tell the man to true it up as large as it will go and it costs less money than to work to close limits. The amount of machine work that there is that can be made in this way is a good big percentage of the work of our shops.

Testing Pressures with Lead Cylinders

*By W. T. Sears**

The use of lead cylinders for ascertaining the amount of pressure between two surfaces is quite old, and the results obtained by this method are undoubtedly sufficiently accurate for most purposes, provided allowance is made for the speed at which compression takes place.

Fortunately lead can be obtained in the market practically pure, that is, within a small fraction of 1 per cent., and the small amount of impurities do not seem to affect the accuracy or likeness of different compression tests.

One proof of this is, that numerous tests made for the Niles-Bement-Pond Company during the last year on the Olsen machine by the testing department of the Olsen Company, agree very closely with each other, and with those which have been obtained from other investigators.

This is the case, however, only when the compression is carried along very slowly.

The speed used on these tests, and the one which gave a load compression curve that compared very closely with the results obtained elsewhere was 0.00007 foot per second.

When the speed or rate of compression was increased to 0.0005 feet per second, there was quite a decided change in this curve.

This is illustrated in Fig. 1; the curves *A* being the result of the slow speed, and the curve *B* of the higher one. The middle curve *A*, No. 2, is the average of eight plugs, and No. 1 and No. 3 are the extremes. The dotted curve *C* is a copy of the Purdue test, furnished by Professor Hatt, of Purdue University.

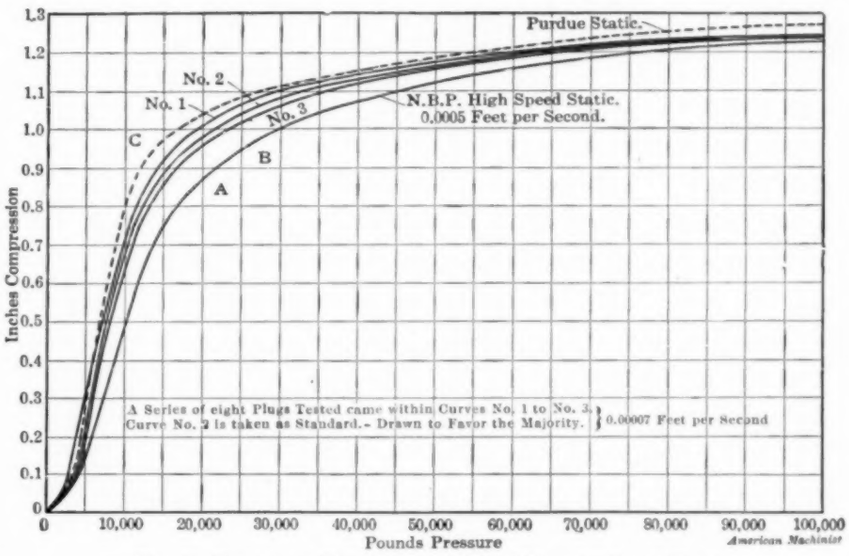


FIG. 1. PRESSURE CURVES FROM 1½x1½-INCH LEAD PLUGS

VARIATION OF ENERGY WITH SPEED

The variation in energy at different speeds is quite generally recognized, but it is doubtful if it is commonly appreciated, at least to the extent it should be by many experimenters who have used the lead-plug method for ascertaining the energy of pressures quickly applied, that is, in the nature of a blow.

Some time ago the engineering bureau of the Niles-Bement-Pond Company began the investigation of the steam consumption and the work of steam hammers, and one of the first devices which was considered for ascertaining the energy of the blow, was by the compression of lead cylinders.

If the energy of the moving parts, at the instant of striking the anvil can be accurately obtained, it is possible to figure from it, the mean effective pressure on the top of the piston, provided the length of stroke and weight of the falling parts are known; it was considered quite necessary in the hammer investigations planned, that information relating to the mean effective pressure should be obtained. As a preliminary, curves were first plotted from the slow compression tests of the lead plugs showing the foot-pounds of energy for different amounts of compression of the plugs.

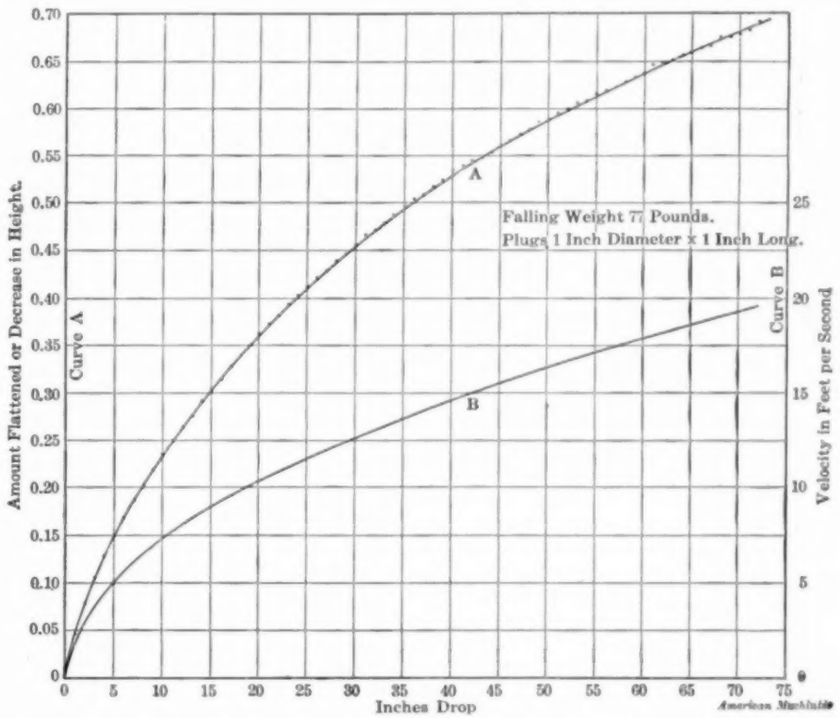


FIG. 2. LEAD PLUG COMPRESSION CURVES FROM WATERTOWN ARSENAL TESTS

DATE OF PRIOR TESTS

It might be as well to state at this point, that the sizes of the plugs adopted by the bureau, of 1½ inches diameter by 1½ inches long, were taken arbitrarily, and because they were of a convenient size to make and handle, and also because plugs of this size were used in the latest tests, which could be found published at that time, that is, those made at the Purdue University by Messrs. Hatt and Turner, and which were published in Proceedings of the American Society for Testing Materials, Volume 4, and extracts printed in the AMERICAN MACHINIST on page 378, Volume 29, Part 2.

A series of tests of plugs of different sizes were made at the Watertown arsenal, and reported in "Tests of Metals" for 1899, page 863, but these were not on plugs of the sizes adopted by the bureau and are, therefore, not directly comparable with the results given in this ar-

*Mechanical engineer, engineering bureau, Niles-Bement-Pond Company.

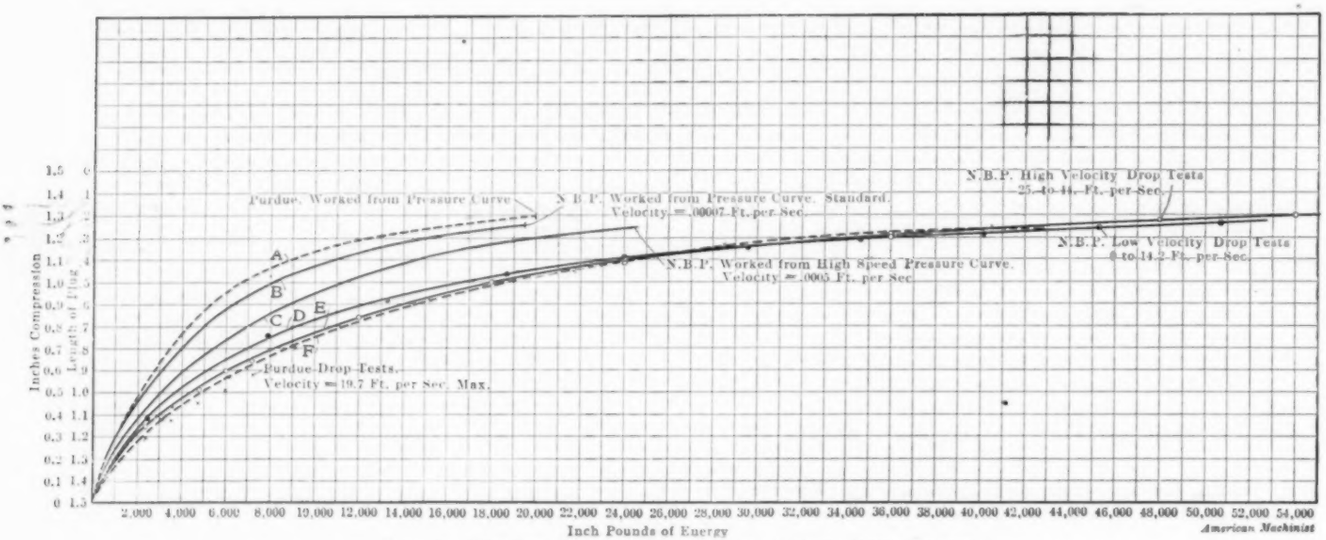

Purdue, Worked from Pressure Curve
N.B.P. Worked from Pressure Curve. Standard Velocity = .0007 Ft. per Sec.
N.B.P. High Velocity Drop Tests 25 to 44 Ft. per Sec.
N.B.P. Low Velocity Drop Tests 6 to 14.2 Ft. per Sec.
N.B.P. Worked from High Speed Pressure Curve. Velocity = .005 Ft. per Sec.
A
B
C
D
E
F
Purdue Drop Tests. Velocity = 19.7 Ft. per Sec. Max.
Inches Compression
Length of Plug
Inch Pounds of Energy
American Machinist

FIG. 3. ENERGY CURVES FROM 1½x1½-INCH LEAD PLUGS

ticle. As a matter of possible interest, the Watertown results on plugs 1 inch diameter by 1 inch long are plotted on chart, Fig. 2, and the velocity curve of the hammer at point of impact, or for the different hights tested is also plotted.

The great variation in speed makes the value of these results questionable for energy measurement, except simply for the compressions and speeds given. In other words, a certain compression would not be a correct measure of energy, unless the compression took place at approximately the same rate at which the test was made.

THE BUREAU TESTS

To return to the bureau tests, it was found that the energy curve figured from the slow compression tests was, of course, no use in the hammer tests, and the first attempt to get correct values was to construct a curve which would be right for the higher speeds at which the hammer would strike, by proportioning it from a curve made up from the Purdue slow and impact tests, and the bureau's slow-moving tests.

While this was fairly satisfactory, at the same time, it was not possible to feel a great deal of confidence in a curve obtained in this manner, and it was finally decided to make some new high-speed tests in which the speeds would be equal to those obtained in actual practice in a steam hammer, in order to get final results which could be depended upon in steam-hammer work.

The velocity of a hammer ram at the instant before impact with the anvil, depends on friction, the total mean effective pressure on the piston and the distance it has fallen through.

For a Niles-Bement-Pond Company 1100-pound steam hammer of 28-inch stroke, the maximum velocity, assuming a constant pressure of 100 pounds per square inch on the piston on its downward stroke, and neglecting friction, would be in the neighborhood of 35 feet per second, and this corresponds to the speed due to gravity alone, acting through a distance of over 30 feet or far greater than any tests of which a record could be found.

The plugs were tested in most cases, one at a time by placing them on an anvil, having a weight of over 8000 pounds and striking them with different size cylindrical weights, weighing from 20 pounds to 200 pounds dropping from different hights up to 360 inches. In addition to a drop on a single plug, the 150-pound weights were tried with two, three and four plugs, and the 200-pound weight with four plugs.

The falling weights were guided top and bottom by two lengths of piano wire stretched tight vertically. The weights were tripped without giving any initial velocity, and there is not much question but that the actual and theoretical velocities at instant of impact were very close, for the apparatus while somewhat crude, seemed to work quite satisfactorily, and the friction loss due to the guides and air was undoubtedly very slight.

There was certainly some loss, even if small, and therefore, the compressions obtained were perhaps a trifle less than they should have been.

RESULTS

The table Fig. 4, gives tabulated results of these tests.

In plotting the energy curves, which are the values that were wanted, it was

Plug No.	Falling Weight, Pounds.	Drop in Inches.	Inch Pounds of Energy.	Plug—Dimensions in Inches. Long.	Upset to	Upset.	Av. Upset.	Striking Vel., Feet per Second.	
13	20	240	4,800	1.489	0.979	0.51	.....	35.9	
14	20	120	2,400	1.494	1.165	0.329	.....	25.4	
15	20	240	4,800	1.492	0.983	0.509	.....	35.9	
16	20	360	7,200	1.492	0.848	0.644	.....	43.9	
17	50	120	6,000	1.492	0.911	0.581	.....	25.4	
18	50	240	12,000	1.492	0.656	0.836	.....	35.9	
19	50	360	18,000	1.492	0.505	0.987	.....	43.9	
20	100	360	36,000	1.491	0.307	1.184	.....	43.9	
21	100	240	24,000	1.491	0.409	1.082	.....	35.9	
22	100	120	12,000	1.489	0.652	0.837	.....	25.4	
23	150	360	54,000	1.491	0.194	1.297	.....	43.9	
24	150	240	36,000	1.495	0.290	1.205	.....	35.9	
25	200	120	24,000	1.492	0.401	1.091	.....	25.4	
26	200	240	48,000	1.493	0.219	1.274	.....	35.9	
27	200	120	24,000	1.489	0.405	1.084	.....	25.4	
28	150	120	18,000	1.492	0.501	0.991	.....	25.4	
29	150	240	36,000	1.502	0.275	1.227	.....	35.9	
30	150	240	36,000	1.503	0.275	1.228	.....	35.9	
31	150	240	36,000	1.498	0.502	0.996	0.993	35.9	
32	150	240	36,000	1.498	0.507	0.991	0.993	35.9	
33	150	240	36,000	1.5	0.670	0.830	0.822	35.9	
34	150	240	36,000	1.498	0.681	0.817	0.822	35.9	
35	150	240	36,000	1.495	0.677	0.818	0.822	35.9	
36	150	240	36,000	1.5	0.769	0.731	0.725	35.9	
37	150	240	36,000	1.5	0.778	0.722	0.725	35.9	
38	150	240	36,000	1.498	0.778	0.720	0.725	35.9	
39	150	240	36,000	1.5	0.771	0.729	0.725	35.9	
40	150	240	36,000	1.498	0.279	1.219	.....	35.9	
41	200	240	84,000	1.497	0.663	0.834	0.842	35.9	
42	200	240	48,000	1.502	0.660	0.842	0.842	35.9	
43	200	240	48,000	1.502	0.660	0.842	0.842	35.9	
44	200	240	48,000	1.502	0.650	0.852	0.842	35.9	
45	200	240	48,000	1.5	0.515	0.985	0.981	43.7	
46	200	356.5	71,300	1.501	0.525	0.976	0.981	43.7	
47	200	356.5	71,300	1.5	0.525	0.975	0.981	43.7	
48	200	356.5	71,300	1.502	0.515	0.987	0.981	43.7	

Weight of Anvil—8660 Pounds.

FIG. 4. RECORD OF COMPRESSION TESTS ON 1½x1½ LEAD PLUGS.

found that there was not so much difference in the higher speeds, as was perhaps to be expected from the considerable difference that occurred at the low speeds.

In other words, the higher the velocity, up to the maximum of speeds tested, the less the energy curves varied.

This is quite clearly illustrated in the final chart, Fig. 3, which gives the energy curves worked up from the different engineering bureau tests and the Purdue tests. It would seem as if after a speed of say 10 feet per second was obtained, that a further increase in compression speed makes very little change.

The speed of 10 feet is simply a guess, and it may be 5 feet or 1, or even less.

This was a point which was not important to the bureau, but it would seem to be vitally important in measuring energy of blows where the speed is low, for all tests so far made show that energy calculations of a slow moving blow cannot be even closely estimated unless the speed is known.

Curve *A* is worked up from the slow-moving or static-pressure test, furnished the engineering bureau by Professor Hatt.

Curves *B* and *C* are the energy curves, resulting from the tests shown in Fig. 1.

Curve *D* is the result of the low velocity drop tests made by the engineering bureau, which are not shown in the tables, but which were made roughly in a hammer, having a falling weight of 1330 pounds, an anvil weight of 16,400 pounds and a maximum drop of 38 inches.

Curve *E* is plotted from the tabulated results given in Fig. 3, and this is the curve that is used at present for hammer calculations.

Curve *F* is plotted from the published results of the Purdue drop tests, in which the maximum velocity is 19 7/10 feet per second.

In order to check up new lots of plugs from time to time, static or slow-moving tests are obtained, and if these agree with previous ones, it is assumed that the action at the high speeds will also be practically the same, thus giving fairly dependable results.

No appreciable difference has been noted in new lead obtained from time to time, or in lead that has been used for tests and remelted.

A Comprehensive Card System for Blueprints *By Everett Hart*

In a previous article on drafting-room system, I mentioned a card system which we have to take care of our blueprints and which I think answers the purpose very nicely in our automobile plant here. I will endeavor to explain the same as it may be a help to other readers of this paper.

A good card system to be a success must possess the following necessary characteristics: (a) to be able at all times to find out just where all blueprints are; (b) whether they are mounted on cardboard or loose; (c) to show on what date the last revision was made, and to show if each holder of a copy is supplied up to date with corrected prints. In other words if he has the latest ones and has returned the old one.

To avoid confusion, revised prints must be sent out promptly and old ones returned to the engineering department to be destroyed. For, while I do not wish to doubt anyone's word or good intention. I insist on getting the old prints back to the engineering department and there checked off by the clerk. Then there will be no excuse at all for having an old print out in the shop to cause needless expense, not to say endless trouble.

The reader will readily see by referring to the cut of our card, that it gives the name of the drawing, material, number, division and group, also whether it supersedes or is superseded by some other number, with date of such supersedence. Under the heading: "Outside Prints," are given all outside firms to which we send prints, together with the date of sending same and under "Replaced," we note date of revised prints. This is done in pencil to allow erasure and the substituting of a new date when a change is made. We therefore have at all times a record of the date on which the last print of this particular number was sent to the firm indicated.

In this connection, we have a blank receipt form on which we indorse carefully the part number of the print, its name and obsoleted print, if any, which is to be returned with the receipt form duly signed by the company receiving the print.

In regard to our factory prints for local use, we have, as shown on the card, 44 spaces. These are the department numbers of which up to date, we have 30. Numbers above this, up to 44, are assigned to the various officials, inspectors, clerks, etc., about the factory. To show whether the department or person has in his possession a mounted or loose print, we mark in the square space under his department number, the following symbols: "o" for a mounted print; "v" for a loose one.

Another aid to perfecting the system is the fact that at the bottom of the card we have left ample space under "Remarks" to serve to allow of clear and concise memoranda being made and yet at all times plainly showing on the card.

NAME PART. NO. S—

MATERIAL DIV. GROUP

NO. REQ. PATT. OR DIE NO. S— SIZE LENGTH

SUPERSEDES S— SUPERSEDED BY S— DATE

OUTSIDE PRINTS	DATE	REPLACED

FACTORY PRINTS

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44

REMARKS

FORM 209. 2500-9-09. American Machinist

COMPREHENSIVE FILE CARD FOR BLUEPRINTS

Up to the present time this system has given complete satisfaction. We think that its beauty and utility lies in the fact that the whole story is told on the card, without having to refer to some other source for the desired information, and I believe that this system, if followed to the letter, will give extra satisfaction to other manufacturing concerns.

Turret Lathe Equipment for Making Automobile Parts

Well Designed Tools for Effecting Rapid Production of Work

By C. L. Goodrich *

In the accompanying illustrations are shown a number of recent adaptations of Pratt & Whitney turret lathes to suit automobile manufacturing requirements.

Tools for Turning and Grooving Pistons

Fig. 1 shows a 2x26-inch turret lathe with piston turning and grooving equipment.

The piston casting is held on an internal gripping chuck as in Fig. 2, having six expanding pins, all of which automatically adapt themselves to the rough, uneven, internal contour of the piston casting and grip it uniformly by movement of one operating member at the rear end of the head spindle. The movement of the expanding pins is positive and holds the piston true as regards the running of its core, which is desirable, as the result after turning a piston held under these conditions is a wall which is of equal thickness throughout.

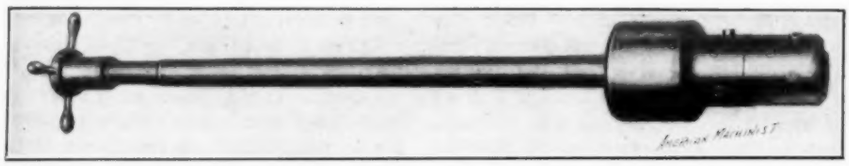


Fig. 2. Internal Gripping Chuck

Overhead Turning Tool

The external turning of the piston is accomplished by what is termed an overhead turning tool; this is so constructed as to clear any tools on the cross slide and so permits of the simultaneous turning of the outside and the forming of the ring grooves, the latter operation being performed by tools in blocks on the cross slide where also are held tools for facing the ends of the piston.

The turning tool is provided with projecting arms as shown in Figs. 1 and 3. The arm enters a support secured to the head of the machine and the effect of so tieing the turning tool to the head is to give extreme rigidity and permit the taking of heavy, coarse feeds without vibration.

The dovetail form of turret face com-

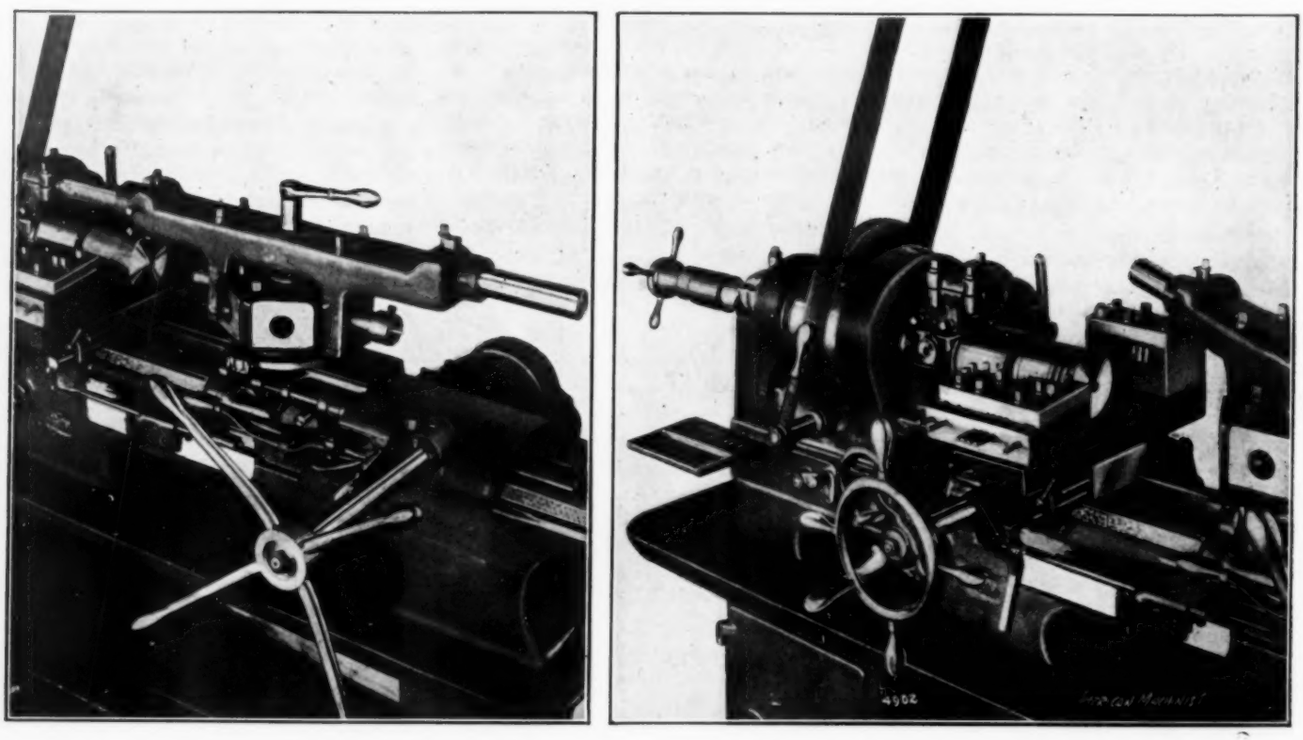


Fig. 1. A 2x26-inch Turret Lathe with Piston Turning and Grooving Equipment

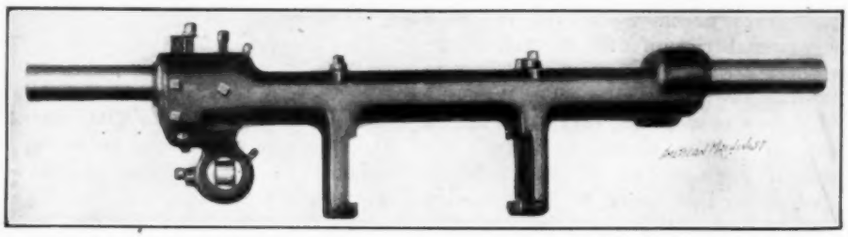


Fig. 3. Piston-turning Tool with Roller Back Rest

*Department foreman, Pratt & Whitney Company.

mon to the Pratt & Whitney turret lathes facilitates the rigid securing of the turning tool to the turret and also permits the fixture to be removed quickly when the machine is to be utilized on other work.

Supports and Sequence of Operations.

In some cases roller supports to take the side thrust of cross slide cuts are found desirable, particularly in cases where centering of the solid end of the piston for a center support is not permissible. Fig. 4 shows such an arrangement, which relieves the spindle of undue strain and supports the work effectively. The operator has no difficulty in attending two of these machines on piston work as both the turret and cross slide are provided with power feed and automatic knockoff.

The scheme of holding the piston by the inside on a true chuck as described, for turning the outside is followed by most automobile manufacturers, although many find it conducive to best results to make this a preliminary operation and rough only the outside to approximately 0.040 inch of size, then heat the piston to remove all strains and afterward refinish the outside. Directly after heat treating the open end of the piston is bored and then the wrist-pin hole is drilled and finally the work is held on a chuck similar to Fig. 5 and the outside finished to grinding size. The chuck, as will be seen, utilizes a pin passing through the wrist-pin hole to clamp by, and centers the piston by entering the open end of the piston just bored. This chuck holds work without distortion and the results are excellent.

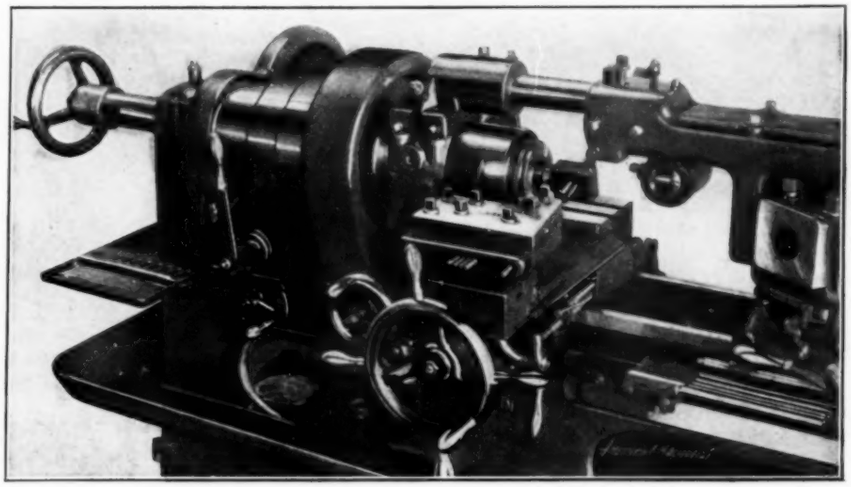


Fig. 4. Piston Turning with Roller Back Rest Tool

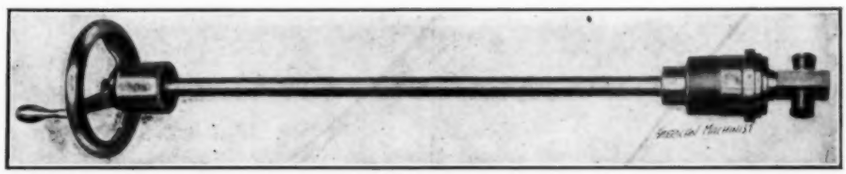


Fig. 5. Chuck for Holding Work for Finish Grinding

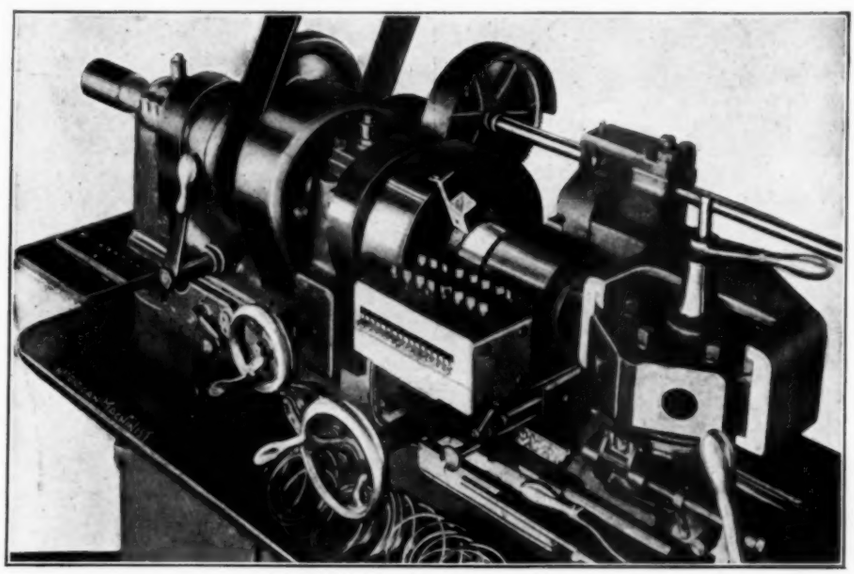


Fig. 6. Machine Equipped with Piston-ring Turning, Boring and Cutting-off Attachment

Finishing Piston Ends

In some designs of pistons the solid end instead of being flat, is formed, and in such cases former bar attachments operating a compound slide on the cross slide have been found satisfactory, as they allow the use of single-point tools to cut the hard scale of the casting in place of formed flat tools.

The time required for the turning and grooving operation varies with conditions and sizes of work but for the common automobile piston used it ranges from 6½ to 12 minutes each; and where a man operates more than one machine the labor cost obviously is low. The simplicity of the equipment insures against frequent stoppages and skilled labor is not required.

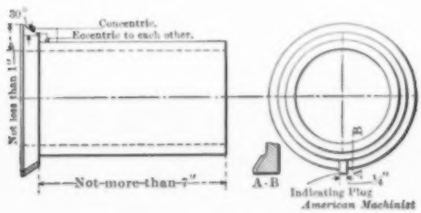


Fig. 7. Piston-ring Pot Casting

Piston Ring Equipment

Fig. 6 illustrates the same machine equipped with piston-ring turning, boring and cutting-off attachments. The rings are made from a pot with flanged end as in Fig. 7 and the latter is clamped in a geared scroll chuck by jaws shaped to suit the flanged end. One casting will make from 12 to 20 ring blanks according to the width of the ring.

The ring-turning fixture body is clamped to two of the turret faces as shown and the turret travels longitudinally as usual. On this body is a cross slide which may move radially in and out. This movement is controlled by a cam made to give the desired eccentricity of the outside piston ring relative to the bore. The cam is journaled in the body of the turning fixture and is rotated positively in unison with the head spindle by gearing connected to a splined shaft as will be seen by referring to Fig. 6.

How the Tools Are Held

The cross slide carries the external turning tool; the internal tool is held in

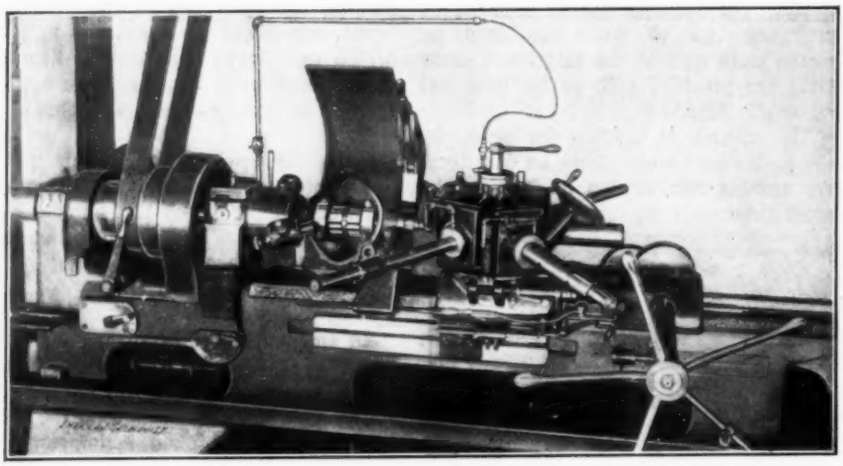


FIG. 8 LATHE EQUIPPED FOR DIFFERENTIAL GEAR-CASE OPERATIONS

a rigid boring bar which has a pilot on its outer end which enters a guide bush in the head of the outside eccentrically and boring of the interior true with the spindle. After these operations have been started the workman brings the cross slide with its multiple cutting-off blades into action and thus this operation is also being accomplished at the same moment as the turning and boring.

The cutting-off blades are set with each slightly in advance of the one next to the left, the tool to the right being placed so as to sever the ring blank entirely from the casting while the next tool has still approximately 1/32 inch to travel before cutting off the second ring,

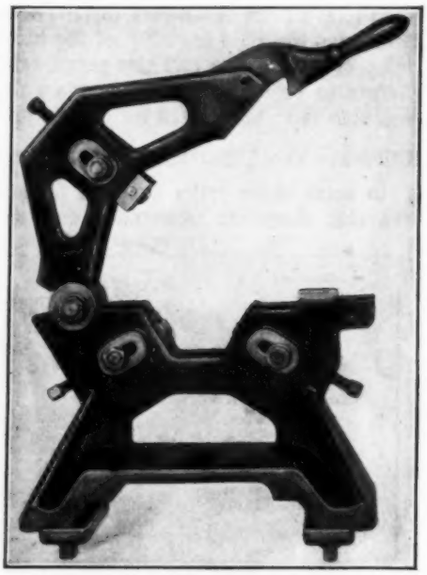


FIG. 9. ROLLER BACK REST USED IN DIFFERENTIAL GEAR CASES

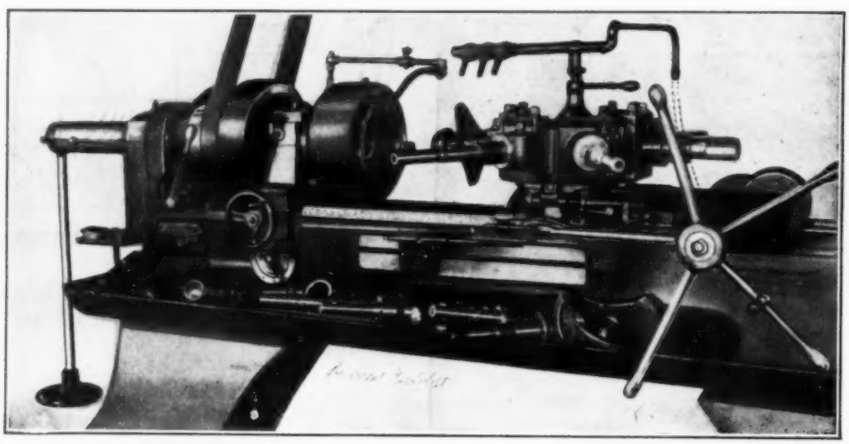


FIG. 10. MACHINING LARGE GEAR-CASE FLANGES

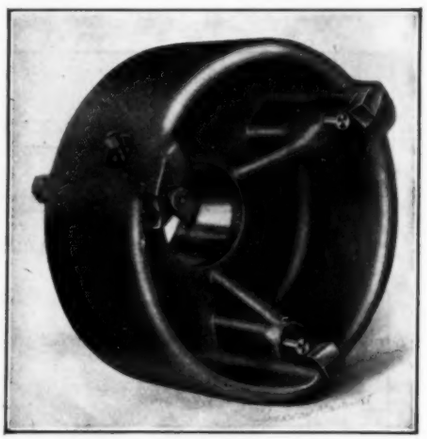


FIG. 12. REAR VIEW OF SPECIAL CHUCK FOR LARGE GEAR-CASE FLANGES

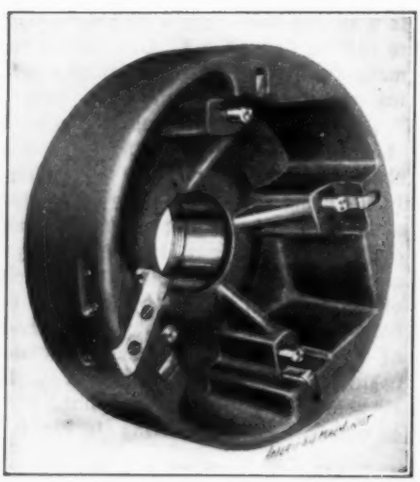


FIG. 11. CHUCK FOR LARGE GEAR-CASE FLANGES

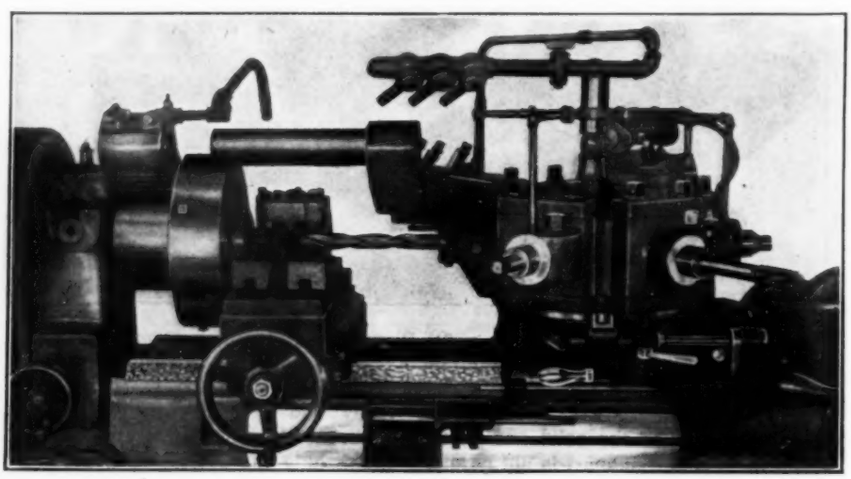


FIG. 13. BORING, TURNING AND FORMING JACK-SHAFT GEARS

and so on. There again one man operates two or more machines, the output of each machine varying with conditions, but for average sizes ranging from 60 to 100 per hour. Attention is called particularly to the ease with which these fixtures may be removed from the machine.

Operations on Gear Cases

A Pratt & Whitney 3x36 turret lathe with equipment for differential gear cases is shown by Figs. 8 and 9. The roller-back rest illustrated supports the outer end of the work while the other end is held by the spindle chuck. Both ends referred to are turned in a previous operation.

The turret tools bore, ream and back-counter bore two holes in each hub and also cut two interior recesses. All cutting tools are provided with internal lubricating devices so that the tools are flooded with cooling liquid permitting rapid cutting. The tools are all equipped with pilots which enter a guide bush in the spindle.

Fig. 10 shows the 3x36-inch turret lathe equipped for boring and facing large gear-case flanges of light cross section. Figs. 11 and 12 show front and rear view of special chuck for holding gear-case flanges. Fig. 13 illustrates an equipment on very heavy work, boring turning and forming jack-shaft gears which gives satisfactory service.

Follow-up System in an Engine Plant

*By Clifton Reeves**

Believing your readers would be interested in a method we are using with success in following up our work through the plant of the Trenton Engine Company, where we manufacture high-speed steam engines, and a line of marine gas engines, I inclose sheet No. 1 of our shop production list. [Reproduced herewith.]

This list is issued from the drawing room and consists of five sheets to cover the parts of steam engines, the first one having the most important parts; second, next in importance, and so on. There are five columns [only one reproduced] which will cover five separate orders for engines. The first division of this column, under patterns and drawings, is for the pattern and drawing numbers of the piece. The second, for material either on hand, ordered, etc., and the third, to indicate whether parts are finished or not.

These lists are checked each morning for the material ordered and received and also for the operations that are finished, so that the progress of the different parts passing through the shop is kept tab on within a few hours.

Under the material column, the clerk checks for material ordered, writing in date it is ordered, and when it is received checks with vertical checking, as shown. He checks the material received from the regular store-room daily receiving sheet, material ordered from the material ordering book, and operations finished from the finished cards which are turned in daily.

By using the vertical system of checking, the exception is that only blank or unchecked spaces are interesting.

This list is made on black print paper, which, of course, is taken from tracing cloth. Copies are sent to our machine-shop foreman and the storekeeper and their lists are checked with the manager's list. It not only serves to indicate the progress of the work, but, as already stated, gives the pattern and drawing numbers of each piece, and we have found that it requires a very short time to check this list if done every morning and keeps tab on the different departments in a very accurate way. Opposite or underneath the name of the part are the several operations put in sequence to finish such part, also the main parts are put in in heavy type and parts belonging to same, for instance, a cylinder, are put near it so that they are grouped.

If there is any further information, I will be very glad to give it as I believe that every shop manager appreciates the value of knowing accurately the conditions of the work in the plant by a simple and inexpensive means.

*Vice-president and works manager, Trenton Engine Company.

One of the latest uses to which alloy steel has been put is in the bridge across the Mississippi river at St. Louis, that was built by the municipality. All of the steel that entered into the construction of this bridge was nickel steel.

SHOP PRODUCTION LIST.

Sheet No. 1.	Order No.		
	Size		
NAME.	Pat. No. Drg. No.	Mat.	F.
Cylinder—Plane or Mill			
Laying out			
Bore & Ream			
Drill & Tap			
Fitting Parts			
Testing			
Adm. Valve Sleeve—Bore			
Turn & Face			
Lay out ports			
Mill Ports			
File Ports			
Main Valve Sleeve—Bore			
Turn & Face			
Lay out Ports			
Mill Ports			
File Ports			
H. P. Stuffing Box—Turn & Bore			
Drill & Tap			
L. P. Stuffing Box—Turn & Bore			
Drill & Tap			
Cyl. Jacket—Lagging—Bands—Fitting			
Frame—Laying out			
Chipping			
Plane or Mill			
Bore & Face			
P. R. Oil Deflector—Bore & Face			
Drill			
V. S. Oil Deflector—Bore & Face			
Drill			
Base—Laying out			
Chipping			
Plane or Mill			
Drill & Tap			
Bore & Face			
Babbitt			
Journal Cap [end] Plane			
Drill			
Journal Cap [center] Plane			
Drill			
Journal Cap [end] Plane			
Drill			
Journal Sleeve [end] Babbitt			
Plane or Mill			
Bore, Turn & Face			
Journal Sleeve [center] Babbitt			
Plane or Mill			
Bore, Turn & Face			
Crank-Shaft—Lay out			
Turn & Face			
Plane or Mill			
Keyseat			
Drill & Tap			
Counter-weight—Slotting			
Drill & Tap			
Fit to Crank-shaft			
Coupling—Turn, Bore & Face			
Drill & Ream			
Keyseat			

Engraving Machines of Various Kinds

By Fred H. Colvin

Engravers often require a dead-center lathe for the same reason that we use dead centers in grinding operations, and Fig. 1 shows a very ingenious method of obtaining this in connection with a regular lathe adapted for their other work. This is secured by mounting a gear on the nose of the regular lathe spindle, this gear driving a pinion which is mounted on the auxiliary head shown, and it can readily be seen how this is accomplished.

Certain classes of engraving are done by mills which are what we would call nurls in the machine shop. A small mill is first engraved by hand of the desired pattern on a tool-steel cylinder and properly hardened. The cylinder is made considerably longer than the design and has the ends roughened by regular nurling so as to engage and turn the pieces it is rolled into.

The mills to be made are then mounted in the machines called "clamps," shown in Fig. 2, as can be seen in the center of the four-rod column, and the hardened master mill is laid on top and brought in contact with the soft-steel rolls, by the two downward projections shown. These are revolved by power and the nurling at the end of the master mill compels the other pieces to turn in unison so that the design is quickly and accurately rolled into the soft-steel rolls, which are to become the mills for actual service.

Fig. 3 shows a steel or copper-plate ruling machine which can be used to produce straight, radial or circular lines, in any desired combination, and is used in engraving plates for bank notes by various governments. The ratchet wheel in front allows a great variety of combinations, including the watered effect which is so attractive.

Fig. 4 shows a much simpler type of this same machine with an indexing cylinder in place of the ratchet wheel, while Fig. 5 shows a machine designed especially for ruling large surfaces quickly. Although only three diamonds are shown in place, it can be arranged to carry a dozen, or even more, and the desired spacing can be very quickly and accurately obtained by the long multiplying lever and the index shown in front. We are indebted for the illustration and information concerning these to John Hope & Sons, Providence, R. I.

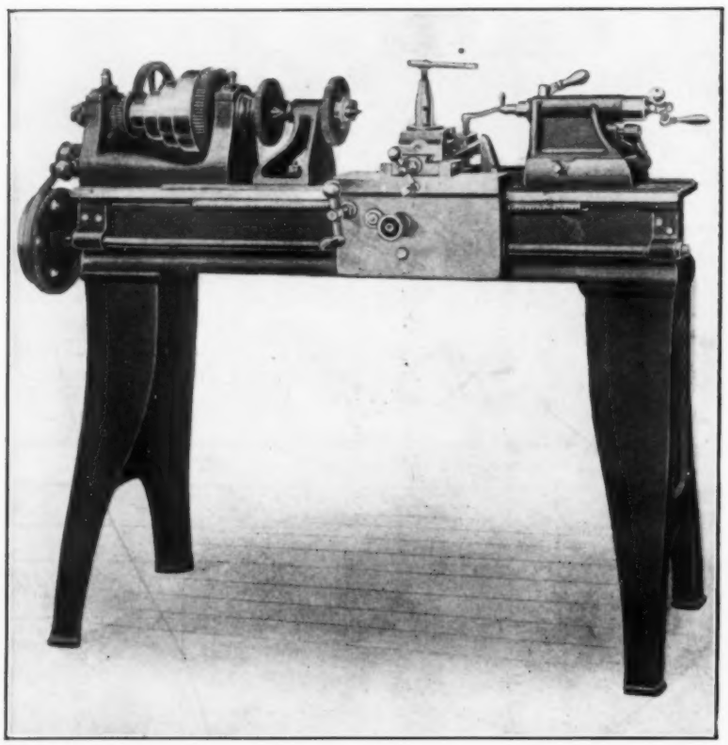


FIG. 1. LATHE WITH DEAD CENTER HEAD

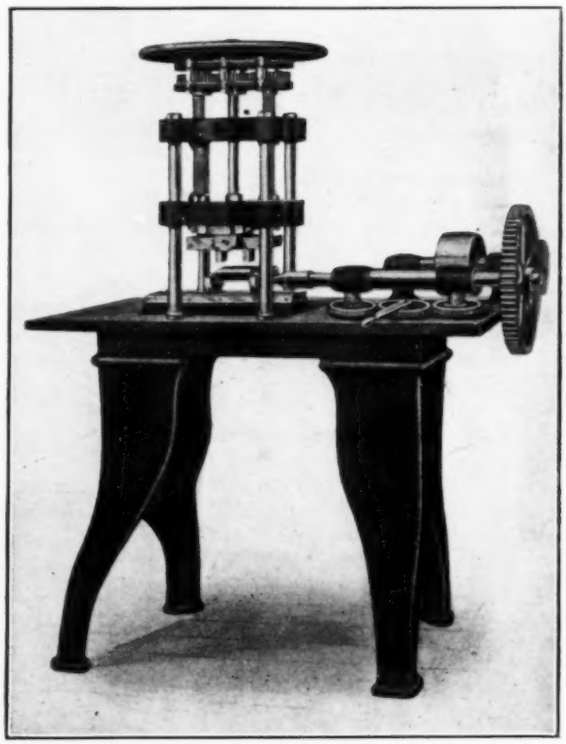


FIG. 2. CLAMPS OR ROLLING MILL FOR NURLS

FIG. 4. RULING MACHINE WITH INDEX WHEEL

FIG. 3. RULING MACHINE WITH RATCHET WHEEL

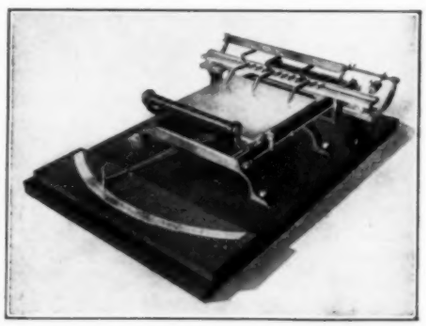


FIG. 5. MULTIPLE RULING MACHINE

Self Generating Spur Gear Machine of English Design

Uses Rack Shaped Cutters Applicable to Spiral Work Also

By I. W. Chubb

The new gear-cutting machine invented by S. Sunderland and made by J. Parkinson & Son, Shipley, generates spurs and spirals and uses a cutter of rack shape. The length of the rack is sufficient to make contact with the blank to the full extent of the teeth in the mating wheel, and the shape of the cutter obviously suits wheels with any number of teeth of the same pitch. The cutter itself reciprocates and rises, while the blank rotates somewhat to give true rolling motion. The cutter having risen a distance equal to the pitch, the blank slides out of gear with it and simultaneously its rotation stops. The cutter slide then falls to the starting position, the blank closes in, its rotary motion is resumed and the cutter reciprocates and rises once more.

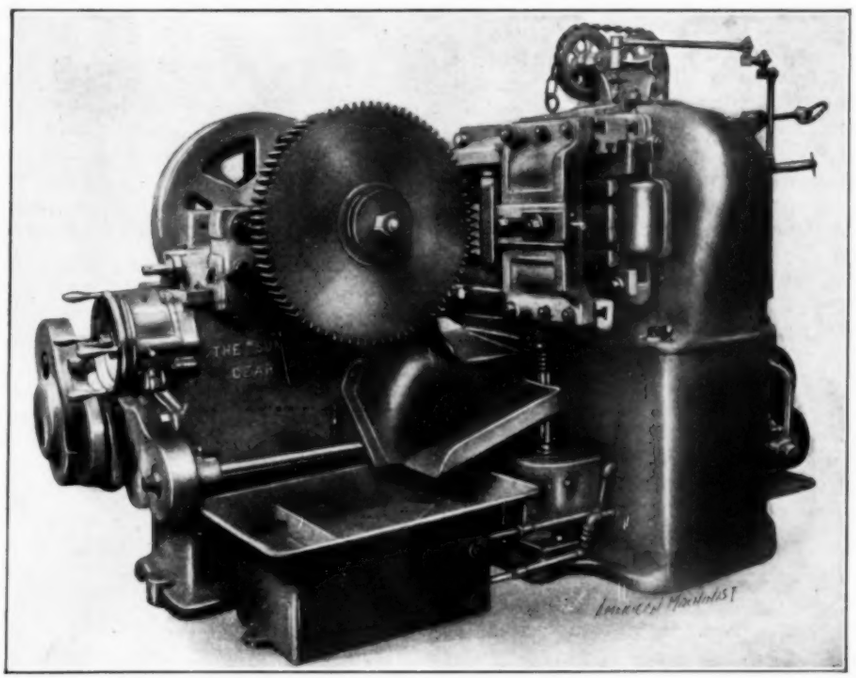


FIG. 1. THE SUNDERLAND GEAR GENERATOR

A general view of the machine as made, with a finished wheel in position, is given in Fig. 1. This particular machine will produce gears from 3 inches to 24 inches in diameter, the maximum width of face being 8½ inches, and the pitch range from 8 to 2½ diametral. It is driven by a single pulley, 16 inches in diameter, running at 350 revolutions per minute, and the belt is 3½ inches wide. The net weight of the machine is about 3½ tons, and the floor space occupied is 5 feet 6 inches by 7 feet 4 inches.

The cutter is made from flat section steel and its form insures that it can easily be ground accurately all over after hardening.

THE CUTTER GRINDER.

For hollow-grinding the faces, a simple machine, Fig. 2, is supplied. On the table the cutter is easily centered to the wheel. This is belt driven and carried on a swinging head so that it can be lowered to the cutter. The table has the usual movements and the appliance hardly calls for detailed description.

As compared with the hobbing process the advantage in cost of the cutters will be more obvious the larger the gear cut, while accuracy of shape can, of course, be assured. The front line of the cutter is inclined somewhat from the vertical, at any rate for the first two or three teeth, but the general idea is that the heavier work is done by the leading teeth so that, as the blank rotates in agreement with the upward motion of the cutter, the lower teeth in the rack tool undertake little more than finishing work, and therefore retain their cutting edge. Fig. 3 shows the cycle of movements. Usually the blank is gone round twice before the teeth are completed to the full depth. The cutting speed can be varied from 20 feet to 40 feet a minute, and two sets of change wheels are employed, one to suit the number of teeth being cut, and the other for the pitches.

CONSTRUCTION OF THE MACHINE.

Three views given in Figs. 4 to 6 illustrate its special features, and although the design has been modified in several respects, yet in essentials the views are correct. It will be seen from the front and side elevations that the headstock slide is balanced by a weight and is moved vertically by a screw driven from below by bevel gear. On the headstock is bolted a plate which can swivel, the curved slots showing the extent of the movement allowed. Placed in the position illustrated in Fig. 4 a spur gear would be cut, but by swiveling the plate so as to incline the line of cut, a spiral gear can be produced, the action of the machine being otherwise exactly the

FIG. 2. THE GEAR-CUTTER GRINDER

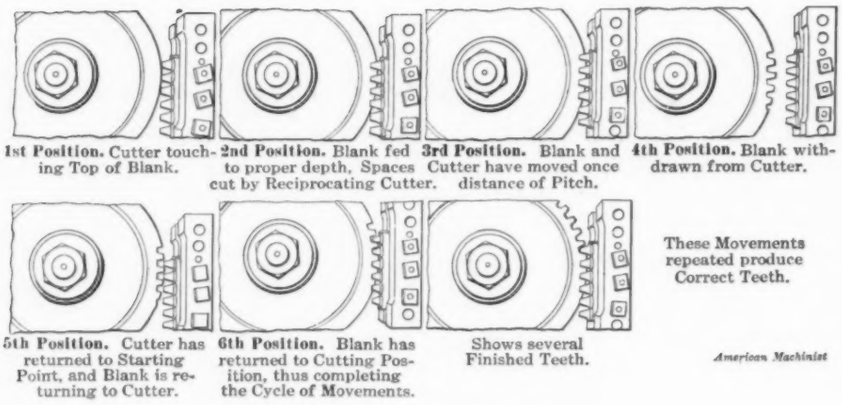

1st Position. Cutter touching Top of Blank.
2nd Position. Blank fed to proper depth. Spaces cut by Reciprocating Cutter.
3rd Position. Blank and Cutter have moved once distance of Pitch.
4th Position. Blank withdrawn from Cutter.
These Movements repeated produce Correct Teeth.
5th Position. Cutter has returned to Starting Point, and Blank is returning to Cutter.
6th Position. Blank has returned to Cutting Position, thus completing the Cycle of Movements.
Shows several Finished Teeth.
American Machinist

FIG. 3. THE CUTTING CYCLE

same. The actual tool head is guided on the swivel plate and carries, of course, the rack-form cutter. The reciprocating motion is obtained by means of a disk stud and block in a slot formed in the tool plate. Rotating motion is obtained from the vertical shaft shown in the front elevation (Fig. 4), at the side of the vertical screw, suitable spur and bevel gears being employed in the transmission. The blank to be cut is carried on a mandrel by means of a bracket which itself can slide on a saddle plate, the position of the bracket being adjusted by a screw for the feed. The arrangement will be clear from Figs. 5 and 6.

The plan, Fig. 6, shows at the end gears with a spur wheel which is shown beside the second cone pulley in Fig. 6 and is in fact keyed to a shaft which bears also a worm and a bevel pinion. This in turn gears with another on a shaft at about the center of the machine.

The plan shows the two worms, one larger than the other and almost side by side. Each gears with a wheel, the two wheels being mounted on the same shaft, but free on it. The arrangement is illustrated rather better in Fig. 1. The bosses of both wheels have clutch teeth so that, according to the position of the shaft, etc., one or other may drive a middle spur wheel, the motion of which can thus be reversed. The spur wheel

The circular block or collar used in conjunction with the gear wheel and spring trigger is keyed to a shaft which is in line with, but not mechanically joined to, the spindle of the gear wheel itself. In the block is carried a spring latch through which the two spindles can be coupled so that the parts rotate together. The shaft which bears the circular block carries at the opposite end a spur wheel which, by means of gears and change wheels on a stud plate, transmits motion to a horizontal shaft bearing a feather-keyed worm, which in turn drives the wormwheel on the gear-blank spindle, and thus produces the necessary rotating motion for the blank. The arrangement of stud, etc., for the change gear will be seen on the left-hand side of Fig. 6 and in a corresponding position in Fig. 4, while the drive is perhaps even better shown in Fig 5. Thus the rotation of the blank spindle depends on rotation of the shaft carrying the circular block. While the reciprocating cutter is acting, the trigger and circular block are rotating together.

TIMING OF BLANK AND CUTTER

The movement by which the blank is caused to slide to or from the cutter at the correct time is as follows. Turning to Fig. 11, an arrangement of latches will be seen. The rotating trigger in its movement eventually bears on the notched

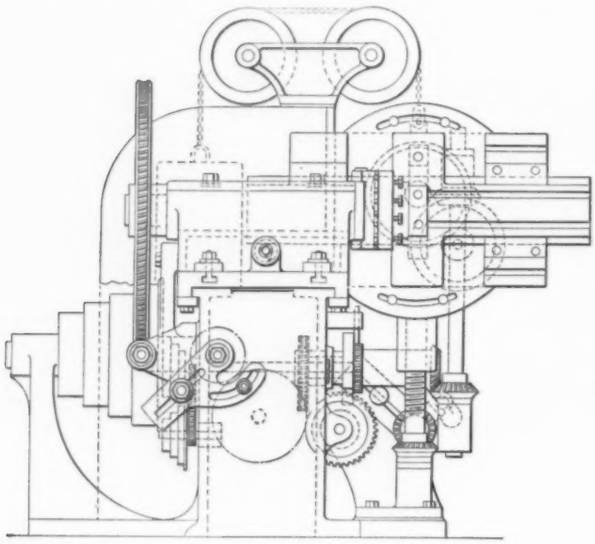


FIG. 4. FRONT OF GEAR GENERATOR

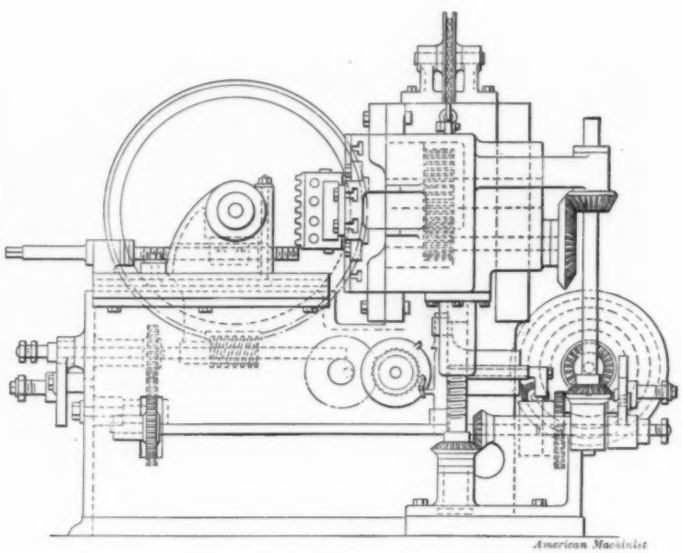


FIG. 5. SIDE VIEW OF GEAR GENERATOR

a cone pulley in this instance for driving, carried on a horizontal shaft which also bears a second and much smaller cone pulley with a worm on the other side of the bearing. At the end of the shaft opposite the cone pulley is a bevel wheel which gears with a similar wheel on the vertical shaft which drives the gear operating the cutter slide. The smaller cone pulley drives a similar pulley, which together with a pinion is mounted on a stud. The pinion in turn itself gears with another of smaller diameter, illustrated in detail in Figs. 8 to 10. It has a ring flange which, together with a collar piece, forms a groove for a trigger, the latter being carried free on the boss of the wheel. To it is secured a helical spring (see Fig. 9) held in tension by pins, one in the trigger and the other in the wheel. The shaft carrying the second wheel is geared by a train to a second shaft which, by bevel gears, gives motion to the vertical screw.

arm, and in one direction forces this upward, as indicated by the arrow, and thus causing a cam to force a spring-held catch bar out of a notch in a vertical bar. The last thereupon falls. With the movement of the bar a spring pawl (see Fig 11) is forced by its spring into engagement with a constantly-rotating ratchet wheel. This is in fact driven by worm and spur gearing from the smaller of the two worms described in connection with Figs. 6 and 7. Thus on each

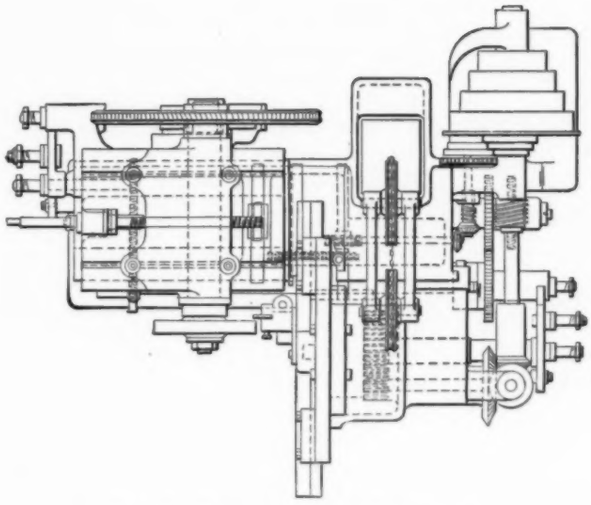
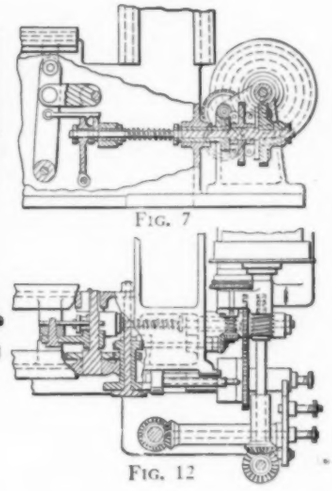
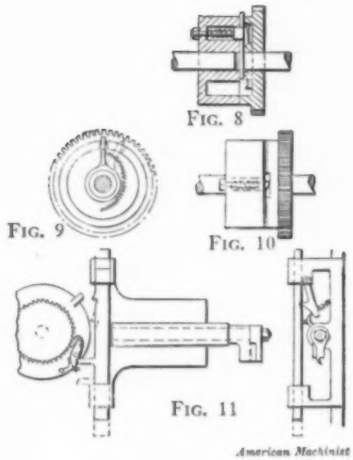


FIG. 6. PLAN OF GEAR GENERATOR





DETAILS OF GEAR GENERATOR

engagement of the pawl with the ratchet wheel, the disk to which the pawl is pinned is given one revolution. On the boss of the disk is secured a spur wheel, which in turn gears with a wheel of double its diameter, keyed on an eccentric shaft as shown in Fig 12. The shaft, therefore, makes half a revolution for each turn of the disk. The eccentric shaft is connected by a short link to a rocking lever which will be seen on the left hand of Fig. 7, and this lever is in turn connected to the saddle plate bearing the bracket for the wheel blanks under cut. Projecting from the disk is a finger (see Fig. 11) which, on rotation of the disk, catches a projection on the rising and falling bar, lifting the latter to its top position. With this movement the pawl is taken out of engagement with the ratchet wheel by the lower arm on the bar, and the latter, when lifted, is suspended as shown in Fig. 11.

In Fig 7 it will be seen that the inner worm wheel is clutched to the central

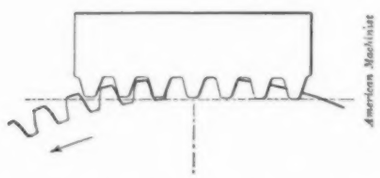


FIG. 13. POSITION OF BLANK AND CUTTER AT END OF CYCLE

spur wheel. In this position the wheel blank is ready for the cutter and the trigger in Figs. 8 to 10 is between the end of the slot and the spring bar. The shaft carrying the circular block is, therefore, rotating with the trigger during the cutting of the teeth and the elevation of the cutter. When the end of the trigger releases the vertical bar, it gives a half rotation to the eccentric shaft as described, so that the blank is forced horizontally clear of the cutter. This of course involves motion of the rocking lever shown in Fig. 7. Connected to this lever is a hooked swinging lever which engages with the top of a small vertical lever pivoted from below and placed at the upper end between two collars on the shaft which supports the gearing. When the saddle plate moves outward, the swinging lever, and with it the shaft, are moved. Thus the smaller worm wheel is declutched from the spur and the larger wheel is clutched instead. In this way the rotation of the shaft, and consequently of the vertical screw, is reversed and at the same time the speed is increased so that the cutter headstock is lowered quickly. Turning again to Figs. 8 to 10, reversal of rotation causes the spring trigger to leave the spring bar. The latter is of course secured to the circular block. Thus the shaft to which this block is keyed, and consequently the blank, are left stationary. Similarly, although the trigger meets the lower arm in Fig. 11 once more, it passes without effect on the position of the vertical bar, while of course the spring bar in the block is shaped to allow the trigger to pass in that direction without driving the shaft. To allow for backlash the trigger makes about one revolution and 1/10 on each reversal.

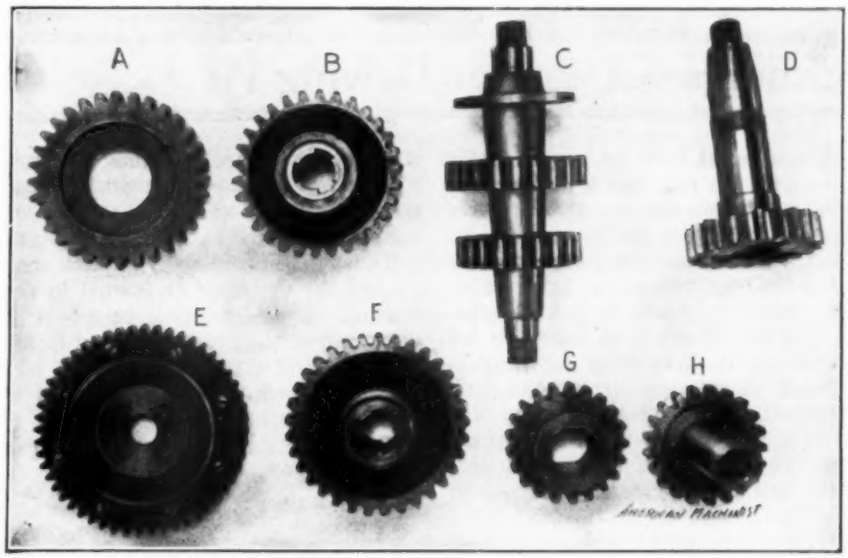


FIG. 14. WORK DONE ON SUNDERLAND GEAR GENERATOR

A—(6 P.) 32T M4 ¾ Face. Time 50 min.
B—(6 D.P.) 30T M4 ¾ Face. Time 45 min.
C—(6 D.P.) 24T M4 ¾ Face.
21T " " Time 35 min. each.
D—(6 D.P.) 22T M4 ⅞ Face. Time 35 min.
E—(8 D.P.) 52T M3 13/16 Face. Time 35 min. Brass and Hard Fiber.
F—(6 D.P.) 33T M4 ¾ Face. Time 55 min.
G—*H*—(6 D.P.) 21T M4 ⅞ Face. Time 35 min. each.

The reversal of the gear wheel shown in Figs. 8 to 10, so as to raise the cutter headstock, can be understood by reference to Fig. 7. On the horizontal shaft, toward the end opposite from the worm gear, will be seen a cam which is

Diametral Pitch	Material.	Number of Teeth.	Width.	Times Around.	Numbers in Gang.	Time for Gang.	Average Time.
8	C.I.	29	1¼″	2	2	20 minutes	10 minutes
	C.I.	141	1¼″	2	1		75 minutes
	C.I.	141 but traversing 2 teeth per cycle	1¼″	2	1		45 minutes
	C.I.	110	1¼″	2	5	65 minutes	13 minutes
7	C.I.	31	3½″	2	1		40 minutes
	C.I.	88	1¼″	2	1		65 minutes
	C.I.	90	1¼″	2	1		60 minutes
6	C.I.	30	2½″	2	1		28 minutes
	C.I.	72	2½″	2	1		55 minutes
	C.I.	85	1¼″	2	1		60 minutes
5	C.I.	40	2″	2	1		34 minutes
	C.I.	75	2″	2	1		65 minutes
	Steel	39	1¼″	2	1		55 minutes
4	C.I.	23	2½″	2	1		35 minutes
	C.I.	65	2½″	2	1		70 minutes
	C.I.	72	2″	2	1		75 minutes
	Steel	23	2″	3	1		60 minutes
	Steel	27	2″	2	1		65 minutes
	Steel	20					45 minutes
	C.I.	52	1¼″	2	2	70 minutes	35 minutes
3	C.I.	53	2½″	2	1		75 minutes
	Steel 45 tons tensile	45	2¾″	2	1		2½ hours
	Steel 45 tons tensile	18	3¾″	2	1		80 minutes
1¼ circular pitch	C.I.	42	2¾″	2	1		100 minutes

TIMES RECORDED FOR CUTTING SPUR GEARS ON SUNDERLAND MACHINE.

feather-keyed in position. This, on rotation, raises the hooked bar clear of the lever at the side of the cam, thus liberating the lever and allowing the spring shown to force the shaft into the position which is illustrated, the smaller worm wheel thus being clutched to the spur wheel. The latter then operates slowly, to drive the screw and raise the headstock. The trigger is then in the position shown by dotted lines in Fig. 9. When it engages with the notched side of the swinging arm (Fig. 11) the vertical bar is freed, putting into motion the ratchet disk, and thus giving the eccentric shaft a half turn, which brings the blank into position for the cutter. Meantime the latter is moving upward, the trigger being in contact with the spring bar, but the helical spring of the trigger is not strong enough to operate the circular block shaft. When the end of the slot in the ring flange engages with the trigger, as in Fig. 10 the blank is put into rotary motion for the period during which it is in engagement with the cutter. By means of the change gear, the connection between the shaft and the worm wheel is arranged so that the pitch line of the blank is rotated in unison with the movement of the cutter until the latter reaches the position shown in Fig. 13. Then the trigger action operates to liberate the vertical bar, and thus to put the eccentric shaft into movement, sliding the blank back out of gear with the cutter and repeating the cycle.

Rate of Producing Work

The accompanying table will give a good idea of the rate at which the machine will work, while Fig. 14 shows times for a set of motor-car gears, which except where indicated are in a very hard steel. As will be noted both the module and the diametral pitch are stated in the caption.

Bushings—A Proper Driving Fit

*By C. H. Beerbaum**

It may be of some interest to readers to consider the fact that a bushing can be driven in too tight to give the best results. As long as the bushing has no occasion to heat up, it matters little how tight it has been driven into place; the instant, however, the bushing warms up, the fact that it has been driven in too tight is very liable to make itself known, especially if the clearance for the shaft or journal on the outside of the bushing is very slight. In this case, if heating occurs, the bushing cannot expand outwardly and all the expansion must occur inwardly.

Say that a bushing left one-thousandth of an inch large on the outside, is driven into place and that heating occurs, the inward shrinkage of the bushing will then have to exceed the one-thousandth of an inch, because the volume of metal represented by the thickness of the one-thousandth of an inch on the outside of the bushing will be considerably greater than the amount represented by the same thickness on the inside of the bushing. In addition to this, the hub or housing into which the bushing is driven is strained or enlarged by the very process of driving and, upon heating, the hub will tend to resume its original dimension, causing an additional amount of compression of the bushing; all of which will have to be taken up by the clearance allowed for the shaft or journal in the bushing. Bushings should be driven in just firmly enough to prevent any looseness under service conditions, and any excess of forcing beyond this point is positively detrimental.

The following rule for clearance has given very general satisfaction:

$$D_b = 1.001 \times D_s + 0.001 \; inch.$$

D_b is the internal diameter of bushing or bearing,

D_s the diameter of shaft or journal.

Expressed in words, the clearance in a bearing should be one-thousandth of an inch, plus an additional thousandth for every inch of the diameter of the shaft.

It is desirable to have the bushing of uniform thickness throughout, that is, a circular section of uniform thickness. Bushings with ribs on the outside, designed to economize material, are liable to have shrinkage strains in them, because when there is an unequal thickness of metal, the metal within the lighter sections cools first and the heavier parts afterward. After such castings are finished and driven into position, the first warming or heating of them tends to distort their inner or wearing surfaces, often giving rise to trouble and annoyance without any apparent reason.

For the same reason, that of economizing material, it is often found that the hub or housing is cut away so that only the ribs are left to support the bushing. This, to some extent, may be done; but, in many cases, it is carried far beyond a permissible limit and leaves an inadequate bearing surface for the outside of the bushing and, on first heating, permanent distortion of the bushing occurs, due to the walls of the bushing sagging between supported points.

*Vice-president, Lumen Bearing Company.

In a shop where they had a lot of plain cast-iron cylinders to bore, the boss made two hinged steady rests which bolted to the top of the carriage. After the first cylinder was set and bored the time consumed in opening the steady rests, taking out the finished cylinder and inserting and clamping a rough casting was not more than two minutes. The boring bar was, of course, held between centers.

Two Semi-automatic Milling Machines

By L. P. Alford

The success with which automatic and semi-automatic milling fixtures can be made for small pieces and adapted to standard milling machines, is well ilustrated by the two devices shown; the first in Figs. 1 to 3 inclusive, the second in Figs. 4 and 5. These fixtures were made and are used at the factory of the Morse Chain Company, Ithaca, N. Y., for milling chain-link studs. The first fixture mills the rounded ends of the studs and is automatic with the exceptio that it must be hand fed. The secon fixture mills two grooves and tw chamfers and is also automatic with the exception of the feed, which is by hand.

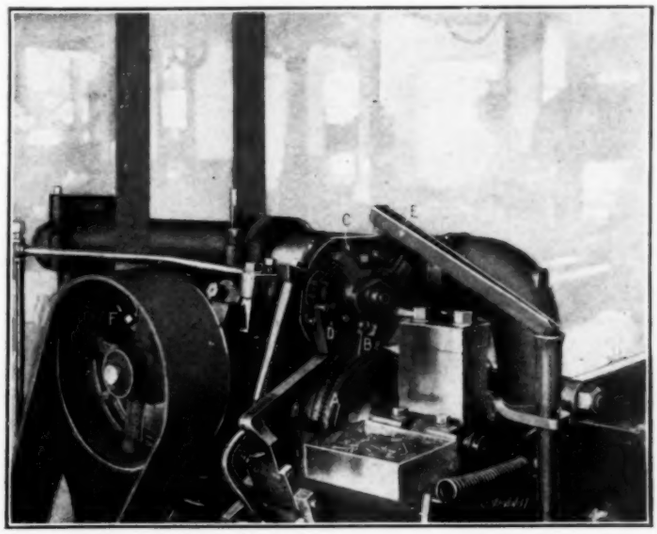


FIG. 1. FEEDING SIDE OF STUD-END MILLING FIXTURE

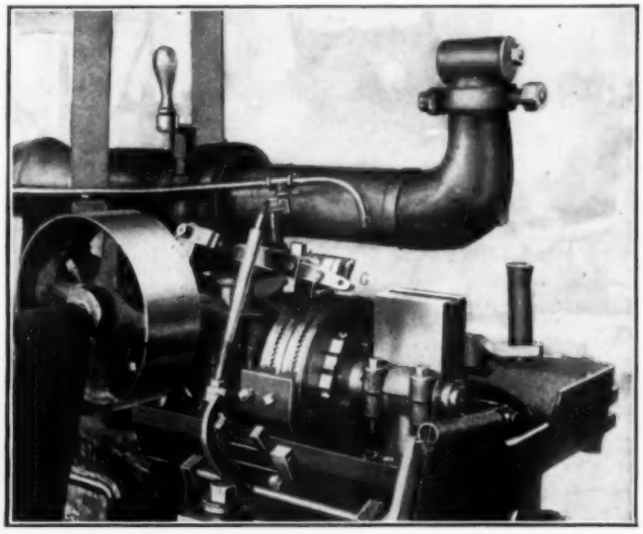


FIG. 2. STUD-END MILLING FIXTURE PARTIALLY DISASSEMBLED

THE STUD-END MILLING FIXTURE

The stud blanks are first sheared from specially rolled wire and are then brought to this machine. The tin pan shown near the lower edge of Fig. 1, is filled with such blanks ready for milling.

The operation of this fixture is briefly this: A blank is inserted by hand, is automatically gripped, carried past a milling cutter and milled on one end, then turned around through an angle of 180 degrees and turned end for end. It is then inserted in another holder, gripped and carried past a second cutter that mills the second end and then it is pushed out into a tube which delivers it to a box or pan.

Needless to say, the mechanism to accomplish this result is somewhat complicated and would require a lengthy description to present it in detail. Therefore, it seems best to describe it in a more general way, as anyone wishing to make a fixture for a particular job would have to adapt the mechanism to the part and could only get help from what had been done through considering and adopting the general principles and methods.

Referring to Fig. 1, stud blanks are inserted in the formed slots in the front disk as indicated by the letter *A*. The entire mechanism of the fixture is driven through the belt pulley shown at the extreme left of the illustration, and from a special countershaft behind the milling machine. As seen in Fig. 1, the disks are rotating downward, and the stud blanks are held in place by a guard which cannot be seen in any of the illustrations, and pushed in until they come to a stop. The two halves of this disk instead of being set parallel, are at a slight angle, so that as they rotate from a position indicated by the letter *A*, to a position 180 degrees therefrom, they come closer together and grip and hold the stud blanks securely. The milling cutters are seen in Fig. 3, and the stud that has been gripped as described is carried past the front cutter and the projecting end is milled. The further rotation of the disk carries the stud to a position indicated by the letter *B*. Here a finger or lifter is inserted between the two halves of the disk and pushes the stud upward into a raceway. In the first part of this raceway is a helix that turns the piece around through an angle of 180 degrees, so that it will be prop-

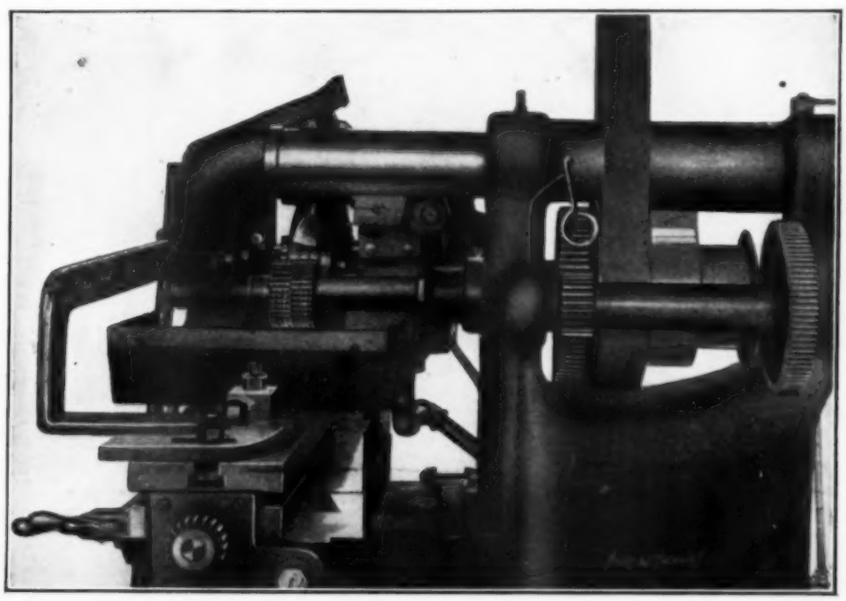


FIG. 3. CUTTER SIDE OF STUD-END MILLING FIXTURE

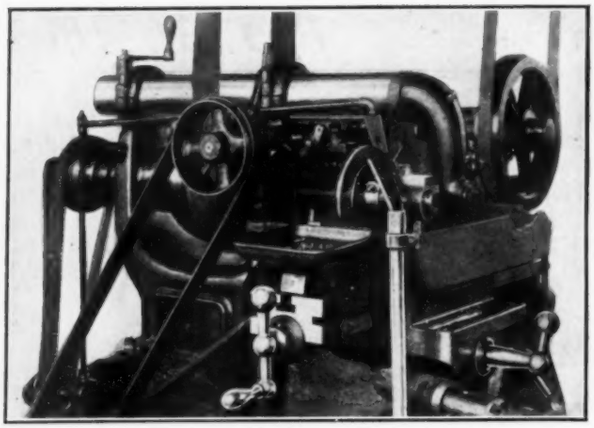


FIG. 4. FEEDING SIDE OF STUD-GROOVE MILLING FIXTURE

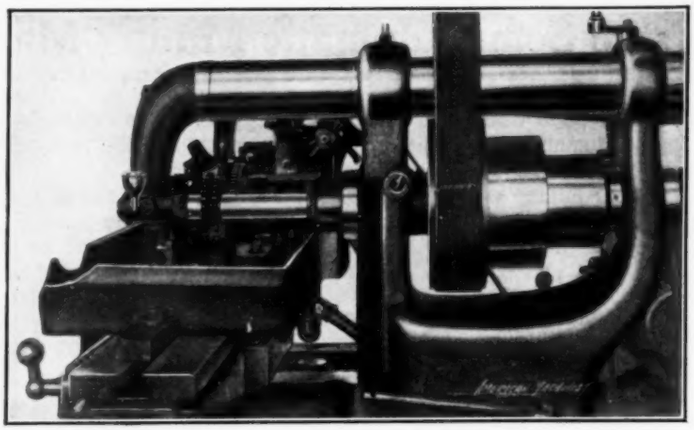


FIG. 5. CUTTER SIDE OF STUD-GROOVE MILLING FIXTURE

erly presented to the second clamping disk to be mentioned later. This raceway is circular in outline, the upper part of it being at *C*. A finger picks off the blanks and pushes them forward one by one, so that there is no danger of their clogging or sticking. At *D* is a driver or pusher that forces the blanks one by one into slots in the second disk. An important feature of this device is a hammer shown at *F* on the pulley and so arranged that if a blank sticks in entering the second clamping disk, this hammer first exerts a spring pressure and then strikes a sharp blow.

The operation of the second clamping disk is identical with the first; the second end of the blank passes the rear milling cutter, is milled, continues on its course, and is picked out by the finger *G* of Fig. 2. It then enters a raceway that extends upward from which the blanks slide down a chute into a box or pan.

STUD GROOVE MILLING FIXTURES

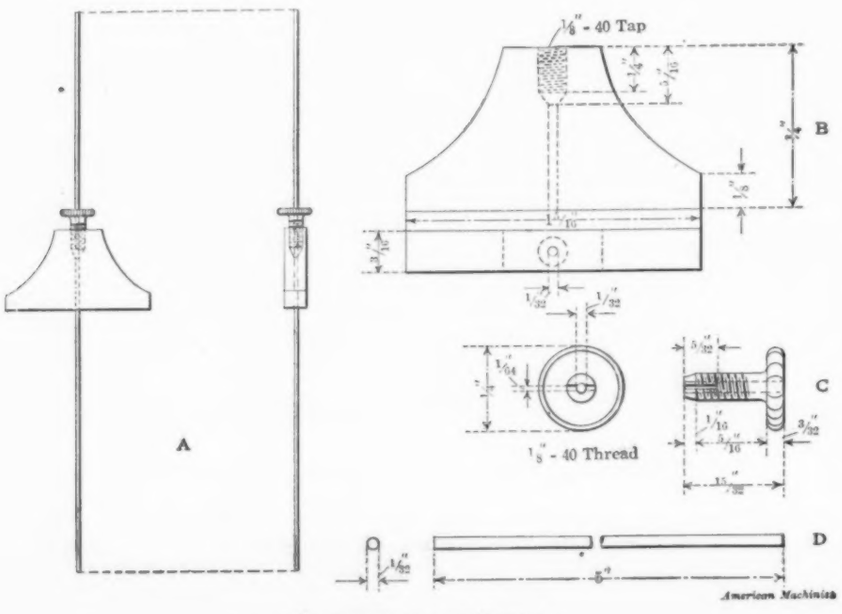
This fixture is similar to the one just described. The studs come here after having been milled in the first fixture and are set into grooves, by hand, in a disk plainly seen in Fig. 4. On the other side of the machine this disk passes between two cutters; see Fig. 5. As the disk rotates the studs pass between guards that locate them endwise and they are then securely clamped before reaching the cutters. There they are milled with a groove and chamfer on each end and passed upward and are kicked out of the disk by means of a little hammer on the back, which cannot be seen in the illustrations. There they enter the chute, as seen in Fig. 4, and are conveyed to a pan or box.

A Depth Gage for Small Work

By L. McEllils

The sketch shows a handy little depth gage for very small holes, which can be made cheaply and quickly. The gage is shown assembled at *A* and *B*; *C* and *D* show enlarged views of parts with their dimensions.

All that is necessary when taking a measurement with the gage is to loosen up on the screw *C*, slide wire *D* through the body *B* to the required depth, and then by giving screw *C* a slight turn to the right, the wire is held firmly in place. I have used this gage for the past few years and find it to be a very useful device.



DEPTH GAGE AND DETAILS

Making Steel Rails with Titanium

The advent of the electric furnace in steel manufacture has made possible the use of titanium alloy in rail manufacture, and a large increase in the use of this alloy has been the result. Such rails are reported as having most successfully stood very severe tests and many of the larger railroads have placed orders for them. The titanium alloy makes bessemer steel more solid, gives it a greater strength and increases its hardness. Why this alloy was not used in rail manufacture previous to the introduction of the electric furnace is explained by the fact that ores containing large proportions of this alloy could not be smelted in the ordinary blast furnace, but now that this objection has been removed the railroads look to this form of rail as a promising solution of so much rail fracture that has been a constant danger in high-speed operation.

Testing Power Presses to Find Capacity and Rating

Proper Procedure in Selecting a Press for Doing Certain Work

By H. Gansslen

Definite data as to the capacity of a power press, that is the maximum pressure it can safely exert without any of its parts being overstrained, are not available, or at least not in such a form that would allow the designer, maker or user to employ them on a broad basis, or for different types of presses to be tested. As a result of this the prospective buyer of a press has to rely on the statements of the different makers, when it comes to a question of the number of tons pressure, which a certain press can exert. And these statements differ enormously, leaving the buyer perfectly in the dark on the subject and also giving unfair bidders an opportunity to obtain an undeserved order by over-rating their press, which they can do with immunity, as the buyer had no simple means heretofore to verify the rated pressure of the machine he bought.

These considerations were one reason for making the researches, the results of which I am giving below to the public interested in this special line of engineering. Another reason for making the researches was the lack of information that would enable one to figure the pressure required to perform certain classes of press work, as set forth below; work on which hardly more than a crude guess could be made and that only by one particularly experienced in the line, and who in spite of his experience was apt to guess wrongly, thereby incurring financial loss to himself or his employer. Oberlin Smith, on page 681 of the AMERICAN MACHINIST of 1901, gives a method for testing the ram pressures of power presses, which for some is all right. But it is unavailable for very short crushers, in which case great accuracy of observation and elimination of the variations in the hardness of different irons—the material he uses for his crushers—is absolutely necessary to obtain results even close enough for practical purposes.

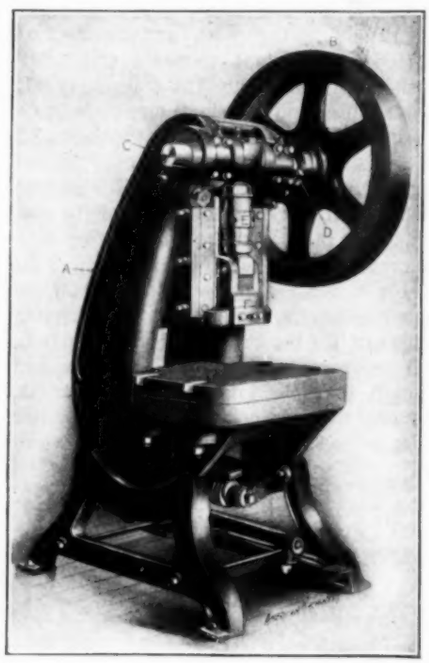


FIG. 1. OPEN-BACK INCLINABLE PRESS

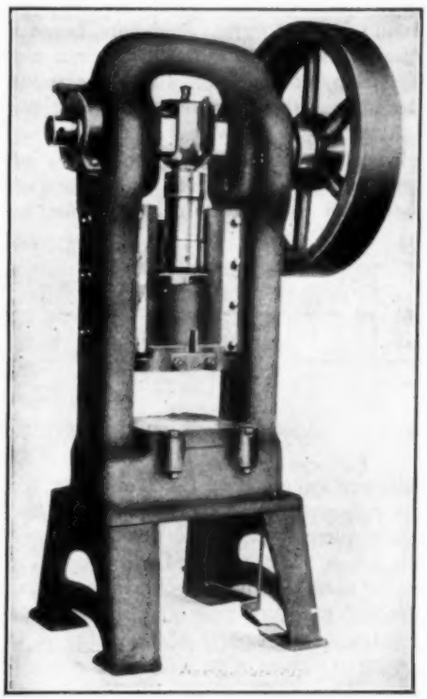


FIG. 2. STRAIGHT-SIDED PRESS

The Lewis Institute at Chicago, Ill., most courteously allowed me to use their well equipped testing laboratory for doing the experimental part of this work, and much credit is due them for thus encouraging research in the field of sheet-metal working, which field is best known by the dark clouds enshrouding its secrets.

TYPES AND SIZES OF PRESSES

The different types and sizes of power presses will naturally necessitate a *method of testing* them which is rather flexible, in contradistinction to hydraulic presses which are of a more uniform type and their capacity as well as the pressure exerted at any moment can be seen at a glance at the pressure gage; and in the testing of which there is no danger of overstraining as the maximum hydraulic pressure prevailing in the main pipes cannot ordinarily be exceeded in well regulated plants. Furthermore the

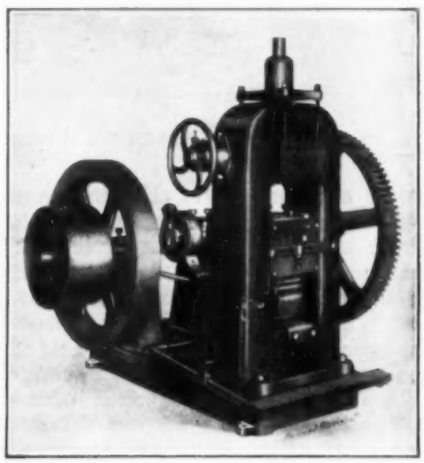


FIG. 3. TOGGLE EMBOSSING OR COINING PRESS

power press, Fig. 1, simple as it seems, is a more complicated mechanism, consisting principally of the frame *A*, the driving wheel *B*, the shaft *C*, the clutch *D*, and connecting the latter two intermittently, the connection *E* and the slide *F* The capacity of this mechanism in its entirety is by no means determined by the proportions or the kind of material of any of these parts but by all of them when assembled, as the strength of any structure is only equal to the strength of its weakest element. Inclinable and similar presses, Fig. 1, are usually made for from about one to 50 tons; straight sided presses, Fig. 2, from 15 to several hundred tons; toggle embossing or coining presses, Fig. 3, from about 200 to 1000 tons, and punching presses, Fig. 4, for sheet-metal working from about 15 to 100 tons capacity.

The rated *capacity* of a power press is usually expressed in tons. It is the pressure acting in line with the motion of the slide which, if exerted at any point of the stroke of the slide, produces no set in any part of the press by exceeding the elastic limit of such a part. It is this capacity that we will deal with presently, more than the *power*.

The power of a press is the number of horsepower required in the belt or motor,

FIG. 4. SOLID-BACK PUNCHING PRESS

as the case may be, to drive the press without exceeding its capacity. As this power is a product of the capacity or maximum pressure and the time or part of the stroke during which that pressure is exerted, it is bound to be depending upon the class of work being done or the stroke of the press, also the number of working strokes per minute. Different pressmakers have adopted different and more or less empirical standards for the drives of their presses, that is the energy of the flywheel and the size of the belt, and even those who have adopted very weak drives have had breakages on their presses and always will have them, so long as they use up the entire energy in the wheel and belt in too short a portion of the stroke as is apt to happen by doing heavy embossing or similar work on a press of the type shown in Figs. 1, 2 and 4. However, the power of a press cannot be dealt with at length here.

METHOD OF MEASURING THE PRESSURE.

The simplest way to measure the pressure which the slide of a press can exert, is to place a properly proportioned cylinder of a suitable material in the press, preferably between hardened and smooth steel blocks, and let the press slide descend and squeeze it, see Fig. 5. From the length of cylinder or crusher, as I will call it hereafter, measured before and after the test, it is possible to figure the maximum pressure which was exerted, assuming that we know the amount which the crusher shortens at every unit of pressure exerted. To find this is merely a matter of calibrating a similar piece on a testing machine.

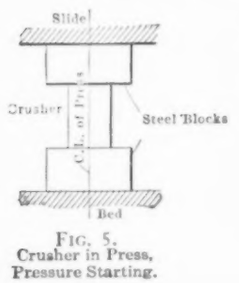


FIG. 5.
Crusher in Press,
Pressure Starting.

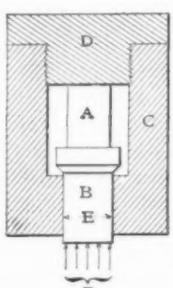


FIG. 6.
"Noble" Pressure
Gage for Cases.
American Machinist

MEASURING THE PRESSURE

The shortening after exceeding the elastic limit is what we are interested in in this field and that in itself is reason enough for not finding sufficient data on the subject in textbooks or anywhere else, as in constructive engineering we mostly deal with deformations below the elastic limit, upon which in fact all the formulas on elasticity and strength of materials are based.

Copper has been used for years for similar purposes and with very satisfactory results, owing to its homogeneity, ductility and uniformity of hardness in its properly annealed and pure state. Electrolytic copper, which is sold in round bars of different diameters, is most suitable for this purpose and is not too expensive due to the limited amount needed and the value it retains for remelting.

I wish here to remind the reader of one field, in which for instance this method is used, namely in the interior

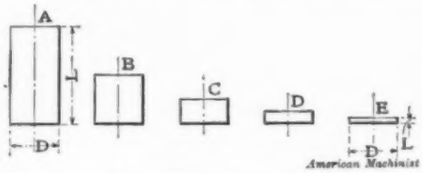


FIG. 7. DIFFERENT CRUSHERS TESTED

ballistics of gunnery for measuring the gas pressure in the bore of the gun, due to the combustion of the powder charge. Fig 6 in a diagrammatical way shows the device used for this purpose, the so-called "Noble" pressure gage at C is the gage housing with head D screwed in; A is the copper crusher on which the gases P press through the piston B. For greatly varying gas pressures different piston diameters E and different proportions of crushers are used. Crushers to be used for press testing must also, necessarily, vary in their proportions to suit conditions. Fig. 7 shows the principal sizes of copper crushers tested, in order to establish the relation between pressure, diameter D and length L. Crusher A has $L = 2D$; B has $L = D$; C has $L = \frac{1}{2}D$; D has $L = \frac{1}{4}D$; E has $L = 1/9D$.

To know the characteristic of a crusher of type E is of importance for testing a coining press, Fig. 3; type A or B would better suit the actual working conditions of inclinable presses Fig. 1, used more frequently for combination die work. All the material used for the tests was commercial electrolytic copper of a

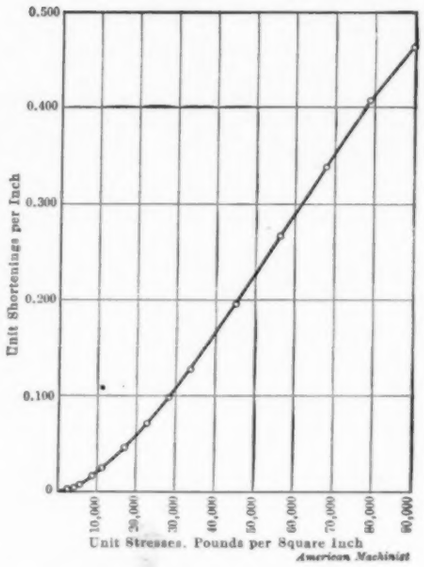


FIG. 8. CURVE FROM TEST OF ANNEALED COPPER CRUSHER

diameter $D = \frac{3}{4}$ inch and came from the same bar. After cutting off the crushers on the milling machine both ends were smoothed and trued up and then all of them were annealed simultaneously by heating to a dark cherry red and quenching in water to insure uniform hardness. It would be too far reaching to give in these columns all the results obtained.

I will in Table 1 and Fig. 8 give the results of a test with one crusher of 0.750 inch original diameter and 1.519 inches original length. The diagram is self explanatory and the small circles indicate practically the readings on the beam of the testing machine. The capacity of the testing machine was 40,000 pounds and the crusher was taken out of the machine for measuring its length after each successive load, as given in column 1 of Table 1. In Fig. 8, as well as in all the other diagrams, the stresses and shortenings are, for the sake of easy comparison, all referred to the unit of area and length of the original crusher; that is, to one square inch area and one inch length and are therefore called "unit

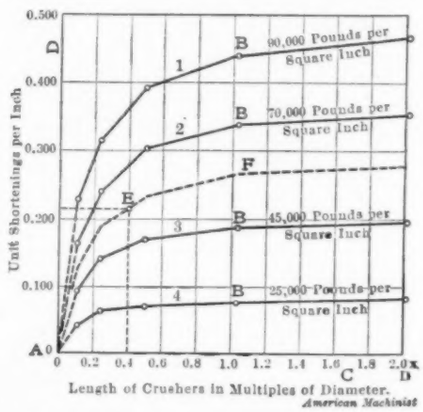


FIG. 9. INFLUENCE OF LENGTH UPON UNIT SHORTENING

stresses" and "unit shortenings." If a crusher before putting it under pressure is 0.750 inch in diameter and 1.519 inches long, and after loading it up with 5000 pounds its length is only 1.482 inches then its shortening is

$$1.519 \text{ inches} - 1.482 = 0.037 \text{ inch}$$

and its unit shortening is

$$0.037 \div 1.519 = 0.0243 \text{ inch.}$$

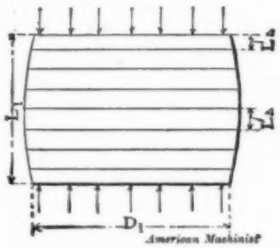


FIG. 10. CRUSHER ORIGINALLY L = D

The unit stress corresponding to this unit shortening was

$$5000 \div \frac{\pi\, 0.750^2}{4} = 11{,}300$$

pounds per square inch.

After this series of tests was completed the results were plotted as per Fig. 9, which is well worth being explained. Take for instance curve 1: A crusher of a length equal to twice the diameter will under a pressure of 90,000 pounds per square inch shorten up 0.465 inch for each inch of its original length; for $L = D$ this is 0.435 inch; for $L = \frac{1}{2}D$ only 0.390 inch; for $L = \frac{1}{4}D$ it is only 0.315 inch, and for $L = 1/9D$ it is very much less, only 0.225 inch, all

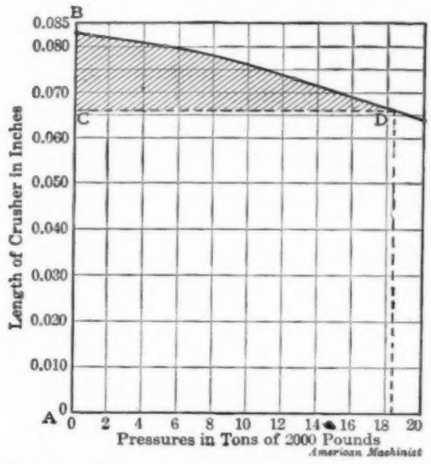


FIG. 11. CHART FOR TESTING LIGHT DUTY PRESSES WITH SHORT STROKE. USE CRUSHER ¾ INCH DIAMETER BY 0.083 INCH THICK

these shortenings being caused by one and the same pressure of 90,000 pounds per square inch. If still shorter crushers are subjected to the same pressure, there would be hardly any impression at all.

The same applies to the other curves, representing pressures of 70,000, 45,000 and 25,000 pounds per square inch for different lengths of crushers. They all point toward one point A and they all are for practical purposes parallel with line $A\,C$ after passing points B, which means that for crushers longer than their diameter, the unit shortenings are practically constant for any certain pressure; whereas, the shorter a crusher is below $L = D$, the smaller its unit shortening gets at that same load until near point A, say at $L = 1/50D$, there is hardly any shortening possible at any pressure. The cause of this is the restriction of the molecular flow and of the lateral expansion due to the friction at the ends of the crusher which increases with the pressure and prevents the particles located near the two end surfaces from taking a prominent part in the deformation. The material being displaced at the ends of longer crushers has a chance to crowd into the central part of the crusher, giving the latter the shape of a barrel.

The principal symptoms of the deformation of a cylinder of an original length equal to its diameter is illustrated in Fig. 10 showing a crusher under load, whose original length was divided up into equal parts $L \triangle$. The intelligent user of a coining press for squeezing operations, where an actual displacement of the material is necessary realizes these facts in a practical way, but he has not had, heretofore, the law, which is laid down in the diagram Fig. 9, and which will enable the maker of such machinery to do more accurate figuring before designing or selling a machine for a given piece of work.

APPLICATION

One of the diagrams of practical use in testing short-stroke presses of small capacity is shown in the chart, Fig. 11. It was obtained by testing a crusher of 0.750 inch diameter and 0.083 inch thickness. To use it make a crusher of electrolytic copper of these dimensions, anneal as outlined above, place it in the press, preferably between two smooth, hard steel blocks, and crush down to the required thickness. Take it out of the press and measure its length, which, for instance, may be 0.066 inch. Follow the vertical line AB to the point 0.066 inch, from there go horizontally to the intersection with the curve and then vertically down, which brings you to 18 1/3 tons, this being the maximum pressure exerted by the press slide at the end of its stroke. For heavier presses take a number of crushers simultaneously but place them slightly apart, so that they cannot touch each other when crushed down. In case of four crushers, for instance, under the same conditions the pressure would have been $4 \times 18\frac{1}{3} = 73\frac{1}{3}$ tons. Instead of proceeding this way in cases of still heavier, say 2000-ton presses, it is preferable or sometimes even necessary to use a single crusher of different dimensions and a corresponding diagram. If it is required to ascertain the pressure necessary during a certain press operation it is possible to do so in some cases by placing one or more crushers below the punch or die holder.

By planimetering the cross-section

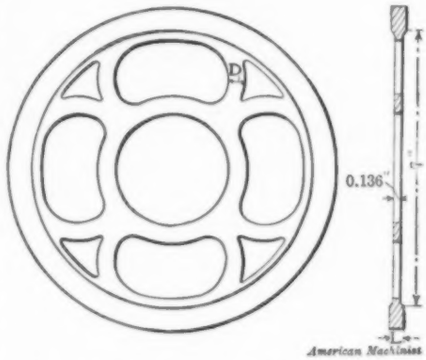


FIG. 12. SPECIMEN OF WORK BEING PERFORMED ON POWER PRESS

lined area $B\,C\,D$, it follows that the energy required to squeeze one of the above crushers was 22.9 foot pounds. Assuming that 95 working strokes were required per minute the theoretical power required to do the work would then be $22.9 \times 95 \div 33{,}000 = 0.065$ horsepower. The flywheel running at 95 revolutions per minute, weighing 400 pounds and having 24 inch diameter at the center of gravity of the rim section, which is equal to a rim speed of $v = 24 \times 95 \div (12 \times 60) = 9.9$ feet per second, would then slow down after each working stroke to a speed of

$$v = \sqrt{9.9^2 - 22.9 \times 64 : 400} = 9.7$$

feet per second, or $(9.9 - 9.7) \div 9.9 \times 100 = 2$ per cent. This loss of speed has to be made up for by the driving belt before the next working stroke takes

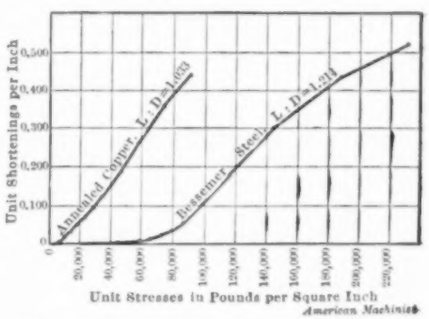


FIG. 13. COMPARISON OF COPPER AND STEEL CRUSHERS

place, if the running of the press is to be continuous.

Besides the above annealed pure copper there were quite a few *other materials* tested with a view to get data on which to base various calculations along the line of stamping and other sheet

metal work. Among those were unannealed copper, Columbia tool steel, both annealed and unannealed, cold-rolled and bessemer steels, brass, aluminum, etc. It does not come within the reach of this article to give all the results.

An Illustrative Example.

To illustrate their application I will give a sample calculation of practical value. The article, as shown in Fig. 12, shall be blanked out of an annealed copper sheet of $L = 0.173$ inch thickness and the central parts of same shall then be squeezed down to 0.136 inch in a power press. It is required to figure the approximate pressure required to do this latter part of the work. For the practical purpose in view it is sufficiently accurate to proceed as follows, although the professional mathematician might have some objections: The average width D of all the parts to be reduced in thickness is 0.420 inch. In analogy with Fig. 7 we have $L \div D = 0.173 \div 0.42 = 0.41$, hence $L = 0.41 + D$. Furthermore the required shortening is to be $0.173 - 0.136 = 0.073$ inch, equal to a unit shortening of 0.037: $0.173 = 0.213$ inch per inch thickness. Turning now to the diagram, Fig. 9, mark 0.213 on axis $A\,D$ and $0.41 \times D$ on the axis $A\,C$, which results in point E in the diagram. An imaginary curve F which can be drawn through point E indicates with sufficient approximation a required pressure of 58,000 pounds or 29 tons per square inch.

Load in Pounds.	Reduced Length, Inches.	Shortening, Inches.	Unit Stress, Pounds per Square Inch.	Unit Shortening in Inches per 1 Inch of Original Length.
1,000	1.517	0.002	2,265	0.0013
1,740	1.515	0.004	3,940	0.0026
2,500	1.509	0.010	5,660	0.0066
3,750	1.496	0.023	8,490	0.0152
5,000	1.482	0.037	11,300	0.0243
7,500	1.450	0.069	16,930	0.0454
10,000	1.412	0.107	22,650	0.0705
12,500	1.371	0.148	28,300	0.0975
15,000	1.326	0.193	34,000	0.1272
20,000	1.223	0.296	45,300	0.1952
25,000	1.112	0.407	56,600	0.2680
30,000	1.005	0.514	67,800	0.3400
35,000	0.898	0.621	79,200	0.4100
40,000	0.807	0.712	90,500	0.4680

TABLE 1. LOG OF TEST OF A COPPER "CRUSHER" SUCH AS IS USED IN TESTING PUNCH PRESSES.

By the way of planimetering it is found that the area of the wheel, which has to be reduced in thickness, is 15¾ square inches, hence the pressure necessary to perform the work will be $15\frac{3}{4} \times 29 = 458$ tons. If this identical piece of work is being made of a certain grade of steel it takes of course a larger pressure due to the greater hardness of steel over copper. To give the reader an idea of this difference I am showing in the diagram, Fig. 13, the unit stresses and corresponding unit shortenings of a bessemer steel and also an annealed-copper crusher. The former was 0.469 inch in diameter and 0.570 inch long, or $L = 1.214 \times D$; the latter 0.750 inch in diameter, 0.775 inch long or $L = 1.033 \times D$. This way of figuring the required capacity or the required size of press has led to results which were entirely borne out by subsequent practical experience.

Other problems, that can be accurately solved by the way of calculation as described above, are upsetting operations used in case of flat rivet heads, etc.

In concluding attention is drawn to what Oberlin Smith said repeatedly and years ago in his book on the general subject of the press working of metals, and the lack of reliable information. Indeed little information of actual value for the engineering profession has been added in the meantime, and what data the trade and the practical man in the shop have are often in too crude and chaotic a shape to be made generally useful. There are great amounts of money spent continually at the laboratories of our schools of engineering, but this branch of engineering is neglected entirely, in comparison with its importance to the community in general.

The Efficiency of Compressed Air

By Snowden B. Redfield

"What is the ratio of the work represented in the compressed air to that done by the compressor?" This is a question often asked and it is a difficult one to answer clearly.

It is fairly well known that the energy transformation in the use of compressed air is not high but the fact that it "does things," some of them better than by any other means and some which are not done by any other means at all, makes the matter of fuel economy of secondary importance. No apology is needed for the use of compressed air today.

That this matter of the fuel economy is not well understood is evidenced by the repeated appearance of propositions to develop the power of a water fall in the form of compressed air and transmit this through pipes to some distant point where its energy, like that of electricity, is supposed to be turned back again into work.

Such power transmission propositions as this are utterly absurd because the losses in the compression and expansion of the air reduce the power efficiency to too low a point. These losses are not losses of pressure by friction, nor air by leakage, but simply losses due to heating and cooling.

It is not a difficult matter to prove that all of the work of compression goes into heat and is lost in pipe-line radiation. All of the work performed at the far end comes from the intrinsic heat originally in the air and the economy obtained depends entirely upon how the air is used. The actual cold compressed air traveling in the pipe does not at all represent the energy put into it by the compressor, as this has all been lost in radiation and the only answer to the question first expounded, is; "Nothing."

However, we all know that the air does work and this may be compared to the compressor work (although they have no direct relation) and in this way an "efficiency" may be stated.

In almost all cases compressed air is used in some form of reciprocating cylinder without expansion; indeed if expansion were allowed (unless reheating is resorted to) while the air could then give up more work, the moisture always present in the air would quickly freeze, choking the exhaust ports and passages of the machine with ice.

As examples of machines using air with little or no expansion, rock drills and pneumatic tools may be cited and some interesting figures as to the efficiency of the power transformation, are given by the accompanying diagrams.

While actually indicating the drill or tool cylinder would be difficult, some rough idea of the indicated horsepower developed within it may be obtained by a little figuring, together with some judicious guessing.

Indicator diagrams of such machines would theoretically be rectangles, but wire drawing and cushioning effects of the valve mechanism would considerably modify this. It may be assumed then, reasoning from such a thing as a steam pump cylinder, without cutoff, that the diagram factor will be about 80 per cent. In other words the actual mean effective pressure will be about 80 per cent. of what the theoretical rectangular diagram would give.

On this basis it is determined that a standard rock drill having a 3-inch diameter cylinder will develop about 6.2 indicated horsepower with 100 pounds at the throttle, this decreasing with the pressure supplied, down to about 3.7 indicated horsepower, with only 60 pounds pressure.

A 3-inch rock drill will require about 138 cubic feet of free air per minute with 100 pounds pressure at the throttle; this decreasing to 90 cubic feet, with only 60 pounds pressure.

Knowing the quantity of air and the

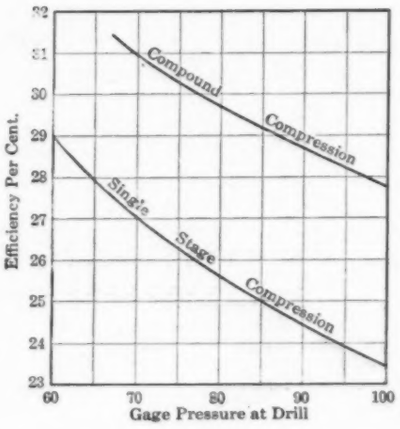


FIG. 1. PROBABLE EFFICIENCY REFERRED TO AIR END OF COMPRESSOR

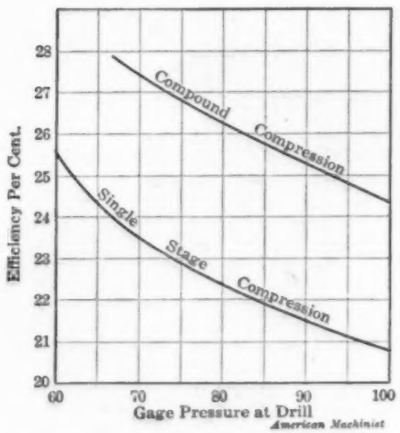


FIG. 2. PROBABLE EFFICIENCY REFERRED TO STEAM END OF COMPRESSOR

pressure, the compressor horsepower is easily calculated.

Thus, allowing 10 pounds pressure drop in the pipe, a 3-inch rock drill will require 29.8 indicated horsepower in the steam cylinders of the compressor with 100 pounds pressure and single-stage compression, or 25.2 indicated horsepower with compound compression. These figures reduce as the pressure used is reduced, but this, of course, reduces the work done by the tool.

Comparing the probable indicated horsepower developed inside the drill cylinder with the actual compressor power required to furnish the air, gives the probable efficiencies shown by the chart. These efficiencies are referred to both the air and steam cylinders of the compressor, so as to give a basis for calculations for various methods of driving the compressor. They include 10 pounds pressure drop in the pipe line.

Referred to the air end of the compressor, it is thus seen that with single stage compression and 100 pounds pressure, about 23.5 per cent. efficiency is obtained, increasing to about 29 per cent. with the low pressure of 60 pounds. Compound air compression brings these figures up to 27.8 per cent. with 100 pounds and 31 per cent. with 70 pounds.

Referred to the steam end, allowing 88 per cent. mechanical efficiency between the steam and air ends of the compressor, single-stage compression gives a little less than 21 per cent. efficiency with 100 pounds and about 25.5 per cent. with 60 pounds air pressure. Compounding the air cylinders of the compressor increases these figures to about 24.5 per cent. with 100 pounds and almost 27½ per cent. with 70 pounds air pressure.

While these figures for efficiency have been determined for rock drills in particular, they apply equally well to almost any machine using compressed air without expansion. It must, however, be remembered that the figures are based upon indicated horsepower only, both in the drill and the compressor. This is because of the impracticability of measuring the "brake horsepower" of the drill. If, however, brake horsepower efficiency is required, these figures for efficiencies of indicated horsepowers can be multiplied by the mechanical efficiency of the device using the air, say 90 per cent. or 80 per cent., as the case may be. This, of course, gives a still smaller result.

It is to be noted that the higher efficiencies are obtained with the lower pressures. This is because there is less loss by heating the air during compression and therefore it is advisable to use pressures as low as is consistent with the size and weight of the machine required to do a given amount of work.

Some Tools Used to Build the Merkel-Light Motor Cycle

The shop of the Merkel-Light Motor Company is in Pottstown, Penn. The product is motor cycles with air cooled cylinders.

Fig. 1 shows a Greenerd arbor press which has been fitted with punches and dies to handle small punch-press work. The stripper is secured to the body of the press and is slotted for adjustment. For the work on which it is used it is very satisfactory.

A CRANK ASSEMBLING JIG

Figs. 2 and 3 show a crank-assembling jig. The disks are turned in one piece with their stems or shafts. The crank-pin hole is put through the disk in another jig. The periphery of the disks is turned a snug sliding fit for the jig. The shaft fits in the hole *A* in the jig. The pins *D* are for the bottom disk of the crank to rest on. The construction of the crank is as follows: The crank pin is in two parts, an internal pin of mild steel for strength and an external sleeve of glass-hard tool steel for a wearing surface. This external sleeve also acts as a distance piece for spacing the disks apart. The pin is a snug tapping fit in both the disks and the sleeve.

When ready to assemble the operator takes a crank disk and pushes a crank pin through it. A sleeve is then tapped into place and the disk thus far assembled is placed, crank pit up, in the jig. The

FIG. 1. AN ARBOR PRESS USED FOR SMALL PUNCHING

connecting rod is then put on the crank pin. The upper disk is then put in the jig with the crank-pin hole opposite the crank pin. The nut is then screwed up tight with the wrench *B*, the Pins *DD* serving also to prevent the disk from turning in the jig while the crank-pin nut is being tightened. When the assembling is finished the threaded key *C* is screwed into the threaded hole in the end of the crank shaft and the whole thing lifted out. Fig 3 at *A* shows the soft-steel crank pin. *B* shows the connecting rod and *C* shows the completed assembled connecting rod and crank shaft. At *D* is shown the socket wrench used for tightening the crank-pin nut.

While it is a simple matter to assemble a crank shaft in line when one has such a jig, it is not by any means a simple job to assemble a crank after taking it apart and get it in one line if one has no jig. Mr. Merkel devised a simple way of overcoming this difficulty, shown in Fig. 4. After the cranks are assembled a center punch mark *A* is made on one of the disks nearly opposite the crank pin *D* but on the periphery of the disk. This center-punch mark is then used as a center. The dividers are set to two inches and an arc of a circle struck off, part of it being on each disk, Two prick-

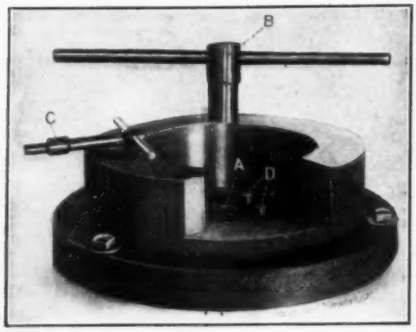


FIG. 2. JIG AND TOOLS FOR ASSEMBLING MOTOR CYCLE DISK CRANKS

punch marks *B* and *C* are then made on this arc, one on each disk. When the repair man without a jig reassembles a crank which he has taken apart, he sets his dividers from *A* to *C* and using *A* as a center, he sees that the prick-punch mark *B* is in correct relation to *A*. This of course brings the crank disks in correct relation to each other.

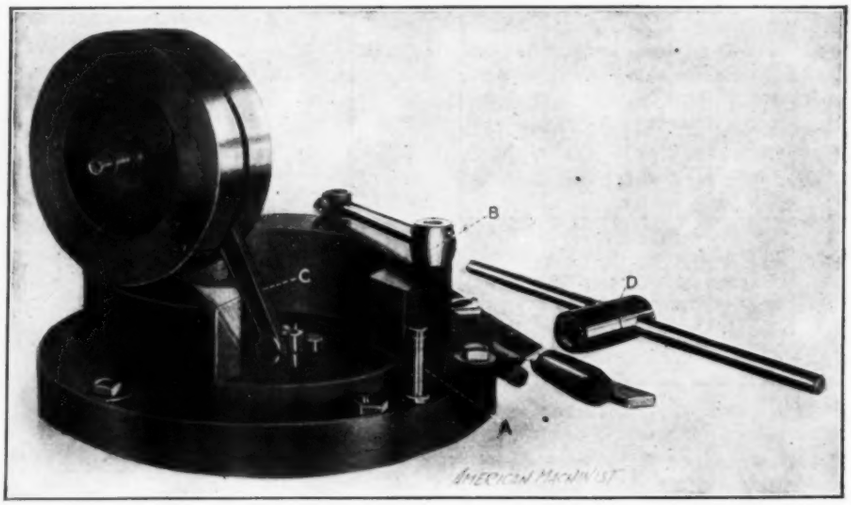
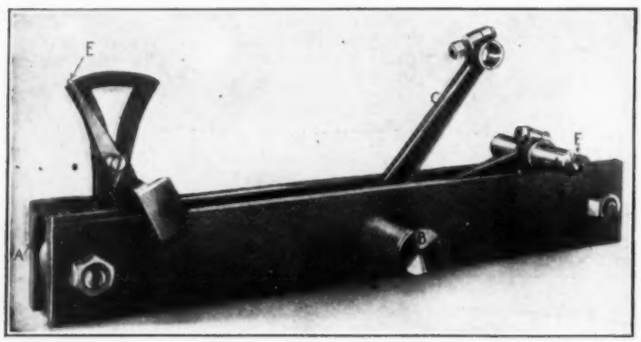


FIG. 3. ASSEMBLED DISK CRANK AND JIG



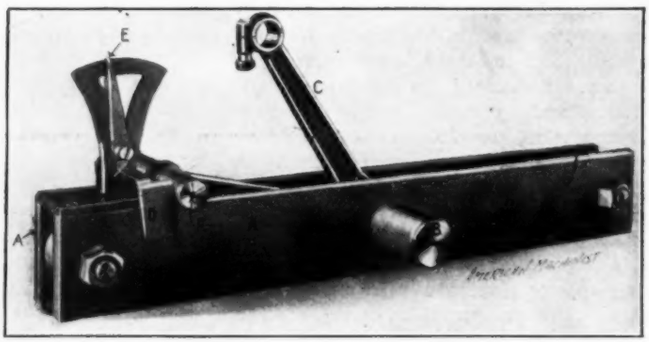


FIG. 5. JIG FOR TESTING ALINEMENT OF HOLES IN CONNECTING RODS

A JIG FOR TESTING THE ALINEMENT OF CRANK AND WRISTPIN HOLES IN CONNECTING RODS

The jig shown in Fig. 5 is for testing the alinement of the holes in the two ends of the connecting rods shown in place in the jig. It consists of two plates *A* parallel to each other and held so by suitable distance pieces.

A hole is bored at right angles to the plates for the pin *B* which fits in one of the holes in the end of the connecting rod. A rod *C* is placed in the jig and the pin *B* run through it. The other hole in the end of the rod has a hardened and ground pin F put in it. At one end of the jig are two surfaces *G*

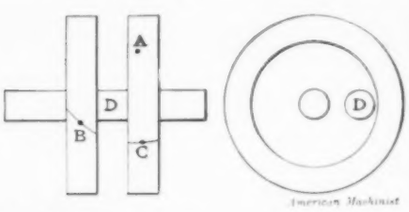


FIG. 4. MARKS TO HELP THE REPAIR MAN

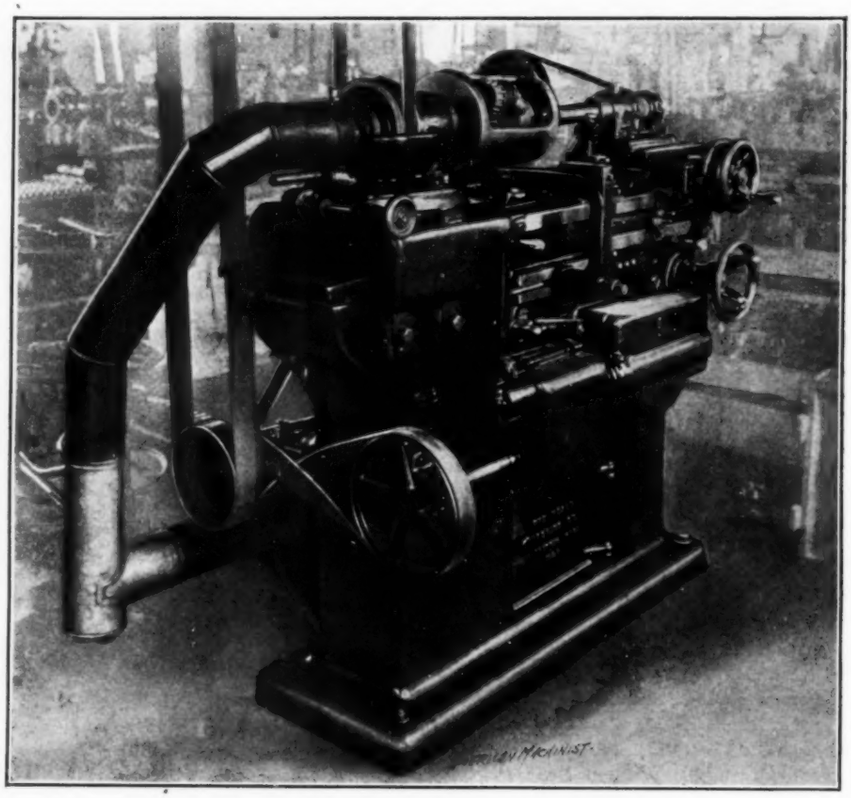


FIG. 6. FINISH GRINDING AIR-COOLED CYLINDERS

which are parallel and in line. The end of the connecting rod, with the pin *F* in place, is swung over toward the surfaces *G*. If both ends of the pin *F* rest on these surfaces, then the hole is in line in the one direction. The rod is then swung over in the other direction. At the other end of the jig is a graduated arc *E*. Pivoted on either side of it are two pointers. The ends of these pointers at *E* are sharp, the other ends of the pointers are as shown at *D*. When the rod is swung so that the pin *F* strikes against the two flat ends *D* of the pointers, the sharp ends register any lack of parallelism of the pin *F* in the direction at right angles to the direction shown at the testing points *G*. If the pin and its hole are in line, then the two pointed ends of the pointers are opposite each other on the arc *E*. The pointers multiply any error.

Grinding Cylinders

After boring, the air cooled cylinders are ground to a finish on the regular Heald grinder shown in Fig. 6. The pipe at the left and back of the machine is connected with an exhaust blower so that all the dust and grindings are drawn off and do not injure the machine or annoy the operator. This method is the opposite of that employed to grind the multiple cylinders of automobiles where the work is stationary and the wheel is rotated. Considerable trouble is experienced with this job as it is difficult to keep the cylinders cool, they being only ⅛ inch thick. Cylinders have been ground in 20 minutes, but it usually takes twice this time to finish a cylinder in a proper manner.

Sizes of Metric Hand Taps

By Charles E. Smart

The first table gives all necessary dimensions for metric hand taps which conform to the Systeme Internationale and all dimensions are given in inches. In each case where the word approximate is used, it means that they have been calculated to the fourth place of decimals but not beyond.

The total length of tap and the length of thread are the same as the tap manufacturers' standard for English measurements, on the sizes nearest the metric dimensions. The diameter of the shank is taken as 0.005 inch below the root diameter of the thread.

The size of the square, up to and including the 24 millimeter pitch top is equal to the shank diameter multiplied by the constant 0.76. Above that size the constant 0.75 is used.

The second part of the table has been found useful in making calculations for special taps. These are mostly used in repairing automobiles made in foreign countries using metric sizes; but where the pitches do not in all cases correspond to the diameters given in the first table. This will be particularly useful to those engaged in automobile repair work.

Diameter, Mm.	Pitch, Mm.	These Dimensions Are All Expressed in Inches (approximately).									
		Diameter, Inches.	Threads per Inch.	Width of Flat.	Pitch Diameter.	Total Length.	Length of Thread.	Length of Shank.	Diameter of Shank.	Length of Square.	Size of Square.
6	1.0	0.2362	25.4	0.0049	0.2106	2	1	1	0.180		0.137
7	1.0	0.2756	25.4	0.0049	0.2500	2	1	1	0.220		0.167
8	1.25	0.3150	20.3	0.0062	0.2830	2	1	1	0.246		0.187
9	1.25	0.3543	20.3	0.0062	0.3223	2	1	1	0.285		0.217
10	1.50	0.3937	16.9	0.0074	0.3553	2	1	1	0.312		0.237
11	1.50	0.4331	16.9	0.0074	0.3947	3	1	1	0.351		0.267
12	1.75	0.4724	14.5	0.0086	0.4276	3	1	1	0.378		0.287
14	2.0	0.5512	12.7	0.0098	0.5001	3	1	1	0.444		0.337
16	2.0	0.6299	12.7	0.0098	0.5788	3	1	2	0.522		0.397
18	2.5	0.7087	10.2	0.0123	0.6448	4	1	2	0.575		0.437
20	2.5	0.7874	10.2	0.0123	0.7235	4	2	2	0.654		0.497
22	2.5	0.8661	10.2	0.0123	0.8022	4	2	2	0.733		0.557
24	3.0	0.9449	8.5	0.0148	0.8682	4	2	2	0.786		0.597
27	3.0	1.0630	8.5	0.0148	0.9863	5	2	2	0.905		0.679
30	3.5	1.1811	7.3	0.0172	1.0916	5	2	2	0.997		0.748
33	3.5	1.2992	7.3	0.0172	1.2097	5	2	3	1.115		0.836
36	4.0	1.4173	6.4	0.0197	1.3150	6	3	3	1.207	1	0.905
39	4.0	1.5354	6.4	0.0197	1.4331	6	3	3	1.325	1	0.994
42	4.5	1.6535	5.6	0.0221	1.5384	6	3	3	1.418	1	1.064
45	4.5	1.7717	5.6	0.0221	1.6566	7	3	3	1.536	1	1.152
48	5.0	1.8898	5.1	0.0248	1.7619	7	3	3	1.629	1	1.222
52	5.0	2.0472	5.1	0.0248	1.9193	8	3	4	1.786	1	1.340
56	5.5	2.2047	4.6	0.0272	2.0641	8	3	4	1.918	1	1.439
60	5.5	2.3622	4.6	0.0272	2.2216	8	4	4	2.076	1	1.557
64	6.0	2.5197	4.2	0.0295	2.3663	8	4	4	2.207	1	1.655
68	6.0	2.6772	4.2	0.0295	2.5238	9	4	4	2.365	1	1.774
72	6.5	2.8346	3.9	0.0319	2.6684	9	4	4	2.497	1	1.873
76	6.5	2.9923	3.9	0.0319	2.8261	9	4	5	2.654	1	1.991
86	7.0	3.1496	3.6	0.0346	2.9706	10	4	5	2.786	1	2.090

METRIC HAND TAPS (Systeme Internationale).

Metric.			Inches (approximate).			Metric.			Inches (approximate).		
Pitch, Mm.	Depth of Thread, Mm.	Double Depth of Thread, Mm.	Threads per Inch.	Depth of Thread, Inches.	Double Depth of Thread, Inches.	Pitch, Mm.	Depth of Thread, Mm.	Double Depth of Thread, Mm.	Threads per Inch.	Depth of Thread, Inches.	Double Depth of Thread, Inches.
0.5	0.3248	0.6495	50.8	0.0128	0.0256	3.5	2.273	4.547	7.3	0.0895	0.1790
0.75	0.4871	0.9743	33.9	0.0192	0.0384	4.0	2.598	5.196	6.4	0.1023	0.2046
1.0	0.6495	1.299	25.4	0.0256	0.0511	4.5	2.923	5.846	5.6	0.1151	0.2301
1.25	0.8119	1.624	20.3	0.0320	0.0639	5.0	3.248	6.495	5.1	0.1279	0.2557
1.5	0.9743	1.949	16.9	0.0384	0.0767	5.5	3.572	7.145	4.6	0.1406	0.2813
1.75	1.137	2.273	14.5	0.0448	0.0895	6.0	3.897	7.794	4.3	0.1534	0.3068
2.0	1.299	2.598	12.7	0.0511	0.1023	6.5	4.222	8.444	3.9	0.1662	0.3324
2.5	1.624	3.248	10.2	0.0639	0.1279	7.0	4.547	9.093	3.6	0.1790	0.3580
3.0	1.949	3.897	8.5	0.0767	0.1534	7.5	4.871	9.743	3.4	0.1918	0.3836

ELEMENTS OF THE METRIC THREAD.

U. S. S. Form of Thread.

The Various Effects of Manganese in Steel

By E. F. Lake

Manganese occurs in nature principally in the form of manganese dioxide MnO_2, which is commonly called black oxide of manganese, but occasionally it is found in other compounds such as braunite, manganite, carbonate, etc. Some of its compounds with oxygen and hydrogen are distinctly acid, while others are distinctly basic and it is in connection with the base-forming elements that it is of interest in steel making. For use in steel making the dioxide is separated from its oxygen, in the presence of charcoal, by employing high temperatures in an electric furnace. It looks like cast iron, is brittle and hard and is combined with iron, to form ferromanganese. Sometimes silicon is added to form ferrosilicon manganese.

Manganese is an element that is always found in steel, but its true properties and effects were not known until about twenty years ago, when they were discovered by R. A. Hadfield, a metallurgist and steel maker of Sheffield, Eng.

When more than 2 per cent. and less than 6 per cent. of manganese is added with the carbon less than 0.5 per cent. it makes steel very brittle, so that it can be powdered under a hand hammer. From 6 per cent. of manganese up, this brittleness gradually disappears until 12 per cent. is reached, when the former strength returns and reaches its maximum at about 14 per cent. After this a decrease in toughness, but not in transverse strength takes place, until 20 per cent. is reached, after which a rapid decrease again takes place. The actual mode of existence of the carbon, however, is very important. Manganese may affect the tensile strength and ductility of steel, either indirectly by retarding the formation of blow holes or directly by entering into chemical combination with the metal.

Steel with from 10 to 15 per cent. of manganese and less than 0.50 per cent. of carbon is very hard and cannot be machined or drilled in the ordinary way; yet it is so tough that it can be twisted and bent into peculiar shapes without breaking. This makes a steel that is only suitable for casting into the desired shape. A process has recently been patented, however, for casting this steel into ingots and then subjecting them to a heat treatment that enables them to be mechanically worked; that is, rolled, forged, etc., and this might possibly be extended to machining operations.

Manganese in the form of a ferro containing about 80 per cent. of manganese is added to a heat of steel at the time of tapping, so that it may sieze the oxygen which is dissolved in the bath and transfer it to the slag as oxide of manganese. Manganese prevents the coarse crystallization that the impurities would otherwise induce, and steels low in phosphorus and sulphur require less manganese than those having comparatively high percentages.

Manganese has a greater affinity than iron for both sulphur and oxygen and therefore is used in steel making for a desulphurizer as well as a dioxidizer. This it does by forming a manganese sulphide (MnS), or a manganese oxide (MnO), and these are taken off in the slag. About four times as much manganese is needed as there is sulphur present, as it does not always catch all of the sulphur to affinitize with; thus if any great amount of sulphur or even phosphorus is present a considerable amount of manganese is desired to counteract the effect of these. If the bath is kept liquid enough and enough manganese is present, no oxygen or sulphur will be found combined with the iron, and if these are not carried off in the slag they are very injurious to the metal. The length of time and the care required, however, make it commercially impractical to reduce the oxygen and sulphur to a trace in this way. Therefore manganese is used to reduce them to commercial percentages and other materials are used to still further remove them for the finer grades of steel. Manganese sulphide will probably weaken steel more than any other impurity if segregated together with phosphide of iron, especially if the metal is rolled, as this magnifies the sulphide by spreading it out during rolling.

Manganese is not only useful to cleanse the bath of impurities but it has other properties that aid in making steel better. The amount that can be left in the steel varies with the amount of various other ingredients that are added to the metal, and this is especially so of carbon. In effect it behaves in practically the same manner as carbon, as also does nickel. With a given carbon content the introduction and increase of manganese causes a series of structural changes similar to those that occur in carbon steels, that only contain small percentages of manganese.

While the action upon iron of these three elements is of the same kind it is not of the same strength, as the equivalent of 1 per cent. of total carbon, that contains the maximum amount of hardening carbon, is 7.25 per cent. of manganese and 17.55 per cent. of nickel. All three of these cause a structural change in the metal from pearlite, that includes the sorbitic to martensite that includes the troostitic and then to the polyhedral structure, and with none of them is a special carbide formed. Chromium has an analogous effect but not as complete as a double carbide of iron and chromium forms, and this is not maintained in solution in the iron without tempering.

The critical temperature to which it is safe to heat steel is raised by manganese owing to its resisting the separation of the crystals in cooling from a liquid, and conferring the quality of hot ductility. It also assists in producing more uniform alloys and tends to make steel crystals smaller by making the metal plastic and thus counteracting the tendency toward crystallization that phosphorus causes, although the metal is more liable to crack when heating or suddenly cooling it from a red heat. The good qualities more than offset the bad, and it is a very useful factor in steel making if the proper percentages are used. It atones for many evils in steel by healing it up and producing a smoothly rolled surface.

In the ordinary steels this percentage is usually from 0.79 to 1 per cent., while in many of the special alloys it runs from 0.30 to 0.50 per cent. In the high-speed steels the manganese content is from 0.10 to 0.30 per cent., and in steels for carbonizing this should be kept below 0.20 per cent. The ductility which it gives to steel, especially when added in the percentages above the zone of brittleness, is decidedly affected by the rate of cooling. In this it works in the opposite way to carbon; slow cooling making manganese steel brittle, while quick cooling makes it extremely ductile.

A peculiar fact that was brought out by some experiments was that a pure nickel-iron alloy that contained from 12 to 13 per cent. of nickel was highly magnetic, but by the addition of 5 per cent. of manganese this metal became as nonmagnetic as brass. While manganese steels are known to be nonmagnetic, it was not known that manganese would have this effect upon nickel; which also makes a nonmagnetic steel when added in certain proportion.

To sum up, manganese alloys with iron in all ratios, it being reduced from its oxides at a white heat by carbon and thus its presence increases the power of carbon to combine with iron at a very high temperature (about 2550 degrees Fahrenheit), and almost entirely prevents its separation into graphitic carbon at the lower temperatures. Manganese prevents a higher total carbon by raising the power of saturation and it is easily separated from iron by oxidation as it is even oxidized by silica. While it does not counteract the cold shortness caused by phosphorus, it does prevent the red and yellow hot shortness caused by sulphur, by removing, reducing or counteracting the effect of iron oxide, silicon and the silicates, phosphorus and copper and by the prevention of ebullition during solidi-

fication and the formation of blow holes.

Manganese retards the formation of blow holes, though not to the extent that silicon does, by preventing the oxidation of carbon and thus the formation of carbonic oxide. This it does by increasing the solubility of the gases that are dissolved in the steel when it is molten and retained in it while solidfying. It probably raises the elastic limit and slightly increases the tensile strength; adds fluidity to the metal; increases hardness; furnishes fusibility when present in considerable quantity, and gives greater plasticity and mobility to the metal at forging heats. Some recent investigations, however, make it doubtful that it diminishes ductility to any extent.

Why One Year's Business Did Not Leave a Profit *By P. S. Locke*

That things often do not turn out as we think they should or as we expect, is shown by the following instance:

A fairly good-sized machine shop had been making several sizes of one kind of machine tool, which for the sake of giving it a name we will call a lathe. The business had prospered and at each annual balance the books had shown a good profit for several years, but at the end of a certain year a loss instead of a gain was disclosed.

The general manager thought the bookkeeper at fault and the bookkeeper defended himself by using the old adage "Figures don't lie." He had used the inventory as given him from the shop and O.K.'d by the superintendent in the same way that he had been doing for a number of years. The superintendent on being brought in to the controversy was at a loss to understand it and showed by his manner the doubt in his mind regarding the truthfulness of figures; he, also, thought it was the bookkeeper who was harboring the brunette gentleman in the wood-pile. After carefully going over all the figures, they were still unable to find where the difficulty lay.

As an aquaintance of the general manager the problem was put up to me for solution.

Beginning of the Investigation

Upon investigation I found the total amount of sales for the year was quite a little in excess of the previous ones. Labor for the year was considerably higher than the increased output appeared to justify. Overhead charges and the items that go to make up operating executive and selling expenses, were not abnormal in any way. Material accounts, with the exception of castings and steel, were seemingly in accord with the amount of business done. Castings and steel were very much out of proportion, but for all that, the general manager and the superintendent thought they could account for this by advances in prices until it was seen that the three items, labor, castings and steel together nearly equaled the difference between their books and what they figured their gain should have been. The books being in balance—the inventory figures gone over and prices compared with former inventories, the items for depreciation found to conform to their usual practice left analysis of the sales the next step in the search.

Investigating the Sales

Taking the sales for the two years previous, I found that of the 10 or more sizes of machines in their catalog, three sizes were the predominant ones and represented about 75 per cent. of the total output. The year we were working on revealed a different state of affairs—one size which was in very little demand during the two years back, had suddenly jumped into prominence and made a big showing in the percentage of sales. Taking their catalog and price list and figuring pound prices on the different sizes showed a range fairly close, with the exception of the one size that made up the lion's share of the sales for the year in question. This size was very much less per pound than the others and indicated the proper direction to pursue in the investigation.

The general manager began to look askance at the superintendent; the latter wanted to get back at me in some way but with those pound-price figures staring him in the face he did not quite see how to do it, and from then on was very much less cordial in his coöperation.

The cost system was one of those crude affairs, gotten up more to fill in spare time of the shipping clerk than to serve any other purpose and only took account of labor and material. It was never proved up with the general books. The shipping clerk, who had formerly been a teamster, until he was injured in an accident and given this combination job as a reward for his faithful record, had never had any previous experience or training. The general manager was not a believer in cost systems, anyway—"The only way you can be sure is to take inventory and balance your books" had always been a favorite expression of his and considering *his* cost system I think he was right. Consulting this so-called cost system we found by comparison, that the proportion of difference between the various sizes coincided very closely with the figures obtained from the catalog. At this point another interesting fact was brought out; the cost figures were kept in the shipping clerk's desk and until someone displayed curiosity enough to ask for them were never handed in nor compared with other figures for different lots.

Why No Profit

Having located the trouble and by some pretty simple figuring found enough to account for the unexpected result, the question came up, how did it happen that the one particular machine mentioned was so much cheaper priced in proportion than the others? Referring again to the catalog, taking the weights given there (though not a very accurate way of getting at such a matter) we found that the ratio of weights was all out of reckoning, with this one machine, in fact, so far that it was only a very little short of the next size larger. The draftsman who was then brought into the consultation and shown the result of the investigation regarding the difference in weight and other oddities displayed by this one size, being nonplussed and evidently fighting for time to gather his wits, suggested looking up the original drawing. Notations on this made it clear that quite a number of changes had been made to suit the special requirements of a customer, four years back. When finished it seemed such an improvement over the former design that it was adopted as a standard. The catalog was changed to agree with the alterations, but even though that one machine was sold as a special for which they got an increased price, the price as a regular size was left at the former figure.

The general manager was mad clean through, at, as he put it, an outsider having to come in to show him how to carry on his own business, although he had been going wrong for nearly a year.

Since that experience, which might have been fatal with a less substantial concern, they have put in a cost system that is what it claims to be, and the general manager has worked out a series of comparative figures that would bring out any important oversight or error in his new cost system.

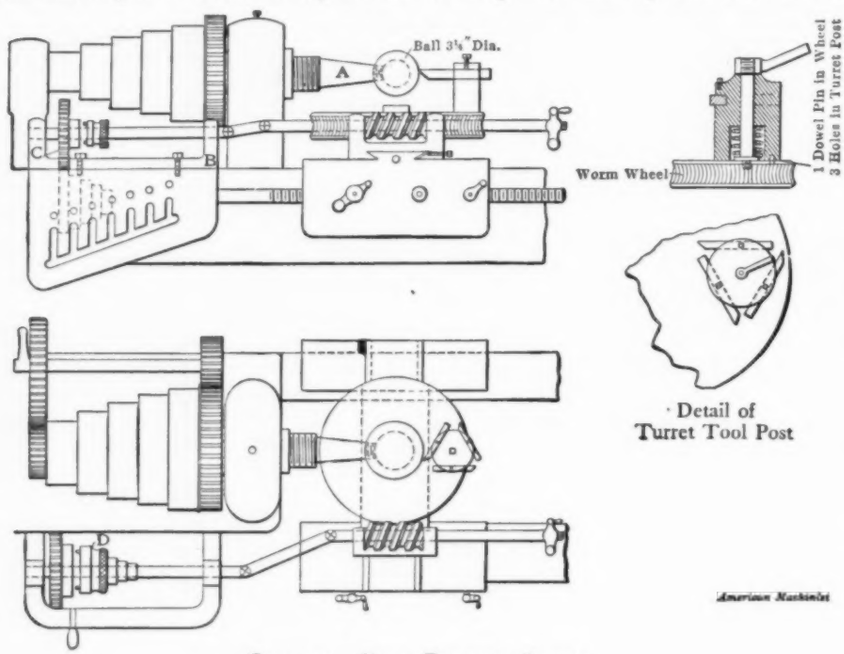
In spite of such occurrences as this you can find machine-shop owners and managers who will laugh at "all the red tape and extra expense of a cost system," saying that "if a man knows his business he does not need a clerk to tell him what he already knows." But a year's profit is a pretty large price to pay for a mistake that a little closer insight and study, and at but slight expense, would save.

Letters *from* Practical Men Concerning *the* Details *of* Making things *in* Machine shops, *from the* First Sketch *to the* Sale

A Neat Ball Turning Device

One of our stock jobs is the turning of hollow cast-iron balls to 3¼-inch diameter, finished. The balls come to us cored out inside with a hole in one side for removal of core. My sketch shows a rig built to fit a 16-inch Hendey lathe, for doing this work accurately and quickly.

The hole in ball is tapped with a pipe thread to receive mandrel *A* which is fitted to nose of lathe spindle. Compound rest of lathe is removed and a worm-wheel substituted, which has a pin in center fitted to counterbore of cross slide. This wheel is fastened with bolts which fit in circular T-slot, and when tightened hold the wheel firmly, though still allowing it to revolve freely around center pivot. On this worm wheel is mounted a turret tool post carrying three tools. The tools are so located that by turning the turret from one station to the next, after each cut, the ball is reduced in three cuts to a well finished surface without adjustment of tools after the initial setting.



CAST-IRON BALL TURNING DEVICE

To automatically revolve worm wheel and tool post, we utilized the gear box by removing cover of same and placing bracket *B* on top. Through this bracket runs a shaft carrying an idle gear *C*; also a clutch collar *D* which slides on a feather. The idle gear was made of such a diameter that it meshed with largest gear in gear case. We connected this shaft by means of a universal joint to the worm which engages worm wheel. To feed, we slip clutch collar along shaft till it engages with idle gear. When disengaged hand feed may be used. The full range of feeds supplied by change gears in gear case can be used by simply changing the lever as in ordinary work. After this operation the ball is removed from mandrel, a plug screwed and riveted in, the ball chucked in a special chuck and surplus of plug removed in the same manner.

Buffalo, N. Y. W. J. BISSETT.

The Square Root by "Home-made" Methods

Most people, unless they have occasion to keep their memory refreshed on the subject, have forgotten how to take the square root and cube root of a number. I admit that I am one of that number. But the method of taking the square root herewith described, is a short cut "kink" which, while not new, is not generally known and the common sense of which should enable the average person to remember it.

To make the matter clear, it will be agreed that the square root of a number is a number which when multiplied by a like number (that is, itself), will give the number whose square root is desired. Now, if we should make a mistake and assume for the square root of a number, a number which was a little too small and if this number is divided into the number whose root is desired, it will give a result somewhat greater than itself. In other words, our divisor is less than the square root and our quotient is greater than the square root. This being the case, if we should take the average of the divisor and the quotient, the result would be very closely the square root of the number desired.

For instance, suppose we desired to find the square root of 150. We know that 12 is the square root of 144 and that 13 is the square root of 169; therefore, 12 is nearer the square root of 150 than 13 is. Now suppose we divide 150 by 12; the answer is 12.5. This shows that 12 is less than the square root of 150 and 12.5 is greater than the square root of 150. Let us take the average of these two. The average of 12 and 12.5 is 12.25. If now we should square 12.25, we will get an answer 150.0625, which it must be admitted is pretty close to 150. In other words 12.25 is the square root of 150, as close as such a method will give; which is probably as near as anybody would want.

Again, suppose we want the square root of 286. We know that 16 squared is 256, and we know, or at least we can soon determine, that the square of 17 is 289. Therefore, the square root of 286 is larger than 16 and smaller than 17, although it is much nearer the latter than the former. Now dividing 286 by 17 we get an answer of 16.82. The square root of 286 then lies somewhere between 16.82 and 17. So, taking the average we have 16.91. This is the square root of 286 very closely, because if you multiply 16.91 by itself you will get an answer of 285.9481 and that is pretty near 286.

You may say that this is all right, but we happened to hit numbers which were very nearly the square root of the numbers desired. To show that the method is remarkably close, even when we do not guess so well, again let us determine the square root of 286, using 16 as our probable square root instead of 17. As the square of 16 is only 256, you will see that we are quite a distance away from the correct answer. Dividing 286 by 16 we have 17.875. The square root of 286 lies somewhere between this number and 16, so taking the average of these two we have 16.937, as the probable square root of 286. As the correct square root of 286 is very closely 16.91, you will see that we are wrong by a little less than 3 in almost 1700, which is an error of about 0.18 of 1 per cent. That isn't much of an error.

The common sense of this method appeals to me so much more strongly than the usual "stilted" method of taking the square root, which gives the exact answer, that I have no trouble in remembering it; whereas I always forget the conventional one soon after looking it up.

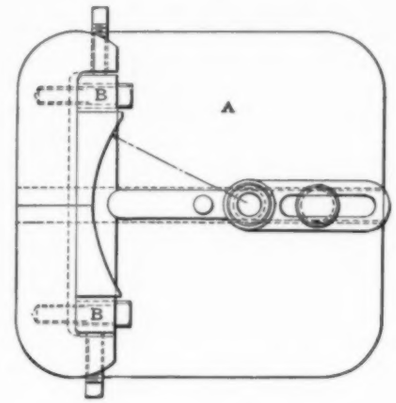
New York City. R. S. BAYARD.

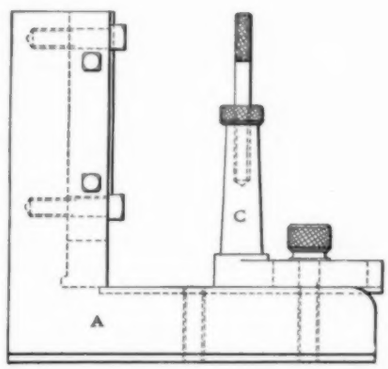
Jigs for Convex and Concave Die Parts

The jigs shown here were designed to facilitate the production of concave and convex die parts for use in the punch press. The call for these parts was such that it was felt that much time should be saved in the actual setting of them up in the lathe. No two sets of these parts were of the same dimensions, or of the same radius, so that whatever was designed must allow for these variations. How this was accomplished is shown by the jigs shown here; Fig. 1 being the convex work.

Referring to Fig. 2; we have an appliance made by one of the diemakers and which formed a part of his kit. This had been a great help to him on many jobs; originally made for the laying out of centers and for wl.ich purpose it was used with a nut and bolt and packing pieces, in much the same way as was shown on page 1004, Volume 32, Part 2, of the AMERICAN MACHINIST. It consists of a piece of mild steel which has one end bent at right angles, and on its upper surface a way is milled for the sliding piece *A*. It has also a slot for the binding screw as shown in the plan.

Supposing a piece was to be machined as shown in Fig. 1; it would first be milled or shaped to the rectangular form and then a center line would be scribed on one side and one end as shown. The attachment in Fig. 2 is then fixed to it with its center line coinciding with the center line on the job. The sliding piece *A*, which has center dots on its center line, is adjusted to the described radius and the arc is marked off. The main part of the surplus metal may now be milled, or planed off, as thought fit, prior to taking the job to the lathe. This having been done, the job may now be set up in the jig, Fig. 3, again with its center line coinciding with the one which is scribed on the hold-down member *C*. This part has a sliding piece *D*, which has center dots on its center line and is adjustable and is also furnished with a binding screw. Both these jigs, Figs. 3 and 4, have a feather on their lower sides to slide in the groove milled in the face plate of the lathe. From this it will be seen that, if the job has been set accurately in the jig, to the lines, adjustment in one direction only, to or from, the center, will be necessary. Setting with the center indicator is generally found to be quicker than setting to an arc of a circle, although, of course, in this case it can be tested by the line as well.





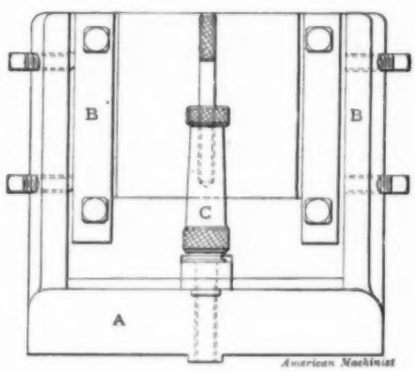


FIG. 4. FIXTURE FOR MACHINING CONCAVE DIE PIECES

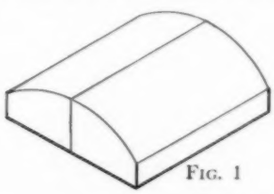
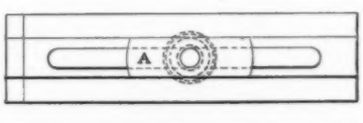


FIG. 1



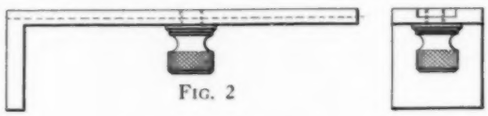
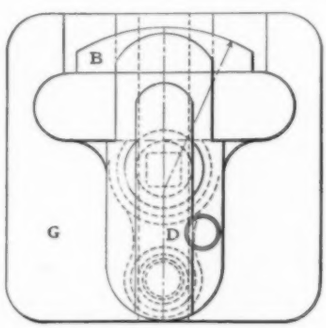
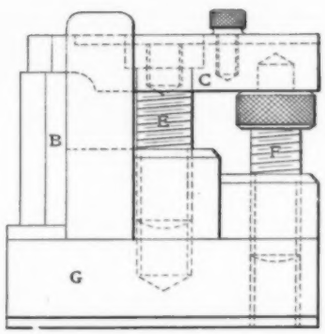


FIG. 2





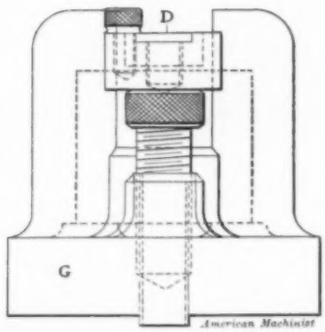


FIG. 3

FIG. 1. CONVEX DIE PART TO BE MACHINED FIG. 2. CENTERING DEVICE
FIG. 3. LATHE FIXTURE FOR TURNING

Inspection of the jig for the concave pieces (Fig. 4) shows it to be really a special angle plate. It is provided with set up pieces to hold the work, and also a post which carries a center dot on its upper end. This post has a base which is adjustable to and from the work and is held in position by a clamp screw. In using this jig it will be found best to set the work with its one side level with the top part of the jig back. The lines may set better this way, although, of course, this is not absolutely essential and it will be seen that the center post is adjustable for different hights. It will be found in using these jigs that their construction permits of the work being removed for trial, or other reasons and almost instantly returned to the correct position for alteration if necessary. They may also be used for grinding after hardening, when the same remarks as to removal and resetting will apply.

In Fig. 4, the jig for the concave pieces

A is the main piece of gray iron *B B* the set-up pieces and *C* the center post.

In Fig. 3, *C* is the hold-down or clamp, *D* the sliding piece, *E* the clamp screw, *F* the adjustable packing screw, and *G* the main member of gray iron. The work itself must be clamped in this jig, before the slide *D* is inserted.

Birmingham, England. ROBERT BROWN.

Thread Tool Holder and Grinding Fixture

The sketches show a "spring" or "gooseneck" thread-tool holder and a

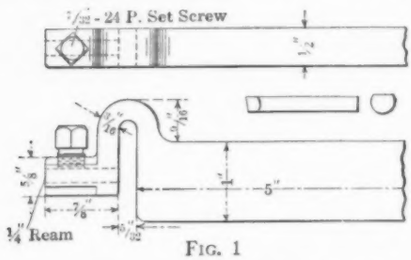
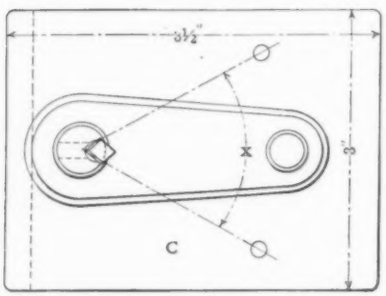


FIG. 1



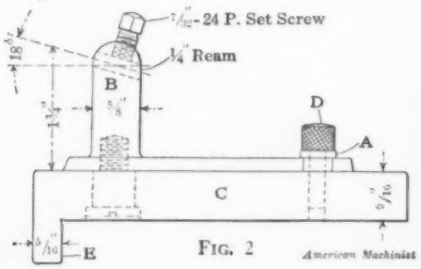


FIG. 2

THREAD-TOOL HOLDER AND GRINDING FIXTURE

simple fixture for grinding the tools used with it. The holder itself is nothing new, as they are seen quite frequently, but the grinding arrangement was entirely new to me until a few months ago I ran across a toolmaker with one in his kit.

The principal dimensions are given, although one may proportion it to his taste, but it should be kept in mind that the smaller and more compact the design the better it fits in the kit.

Fig. 1 shows the holder, made of a medium quality of tool steel, hardened and nicely tempered, especially at the neck.

Fig. 2 shows the grinding fixture. Base *C* is of cast iron finished all over with the bottom or sliding surface scraped to a bearing. Post *B* is made integral with the arm which carried the bushing *A* for locating plug *D*. The hole in *B* for holding the tool while grinding is drilled at an angle of about 18 degrees, which is about right for the diameters and pitches of threads the tool would be used on. Angle *x* will have to be determined, as it must vary from 60 degrees for grinding a 60-degree tool, on account of the clearance angle. A plug can be turned up in the lathe to the same angle as the thread which the tool is to cut, with a shank to fit the ¼-inch hole in *B* and placed therein, then by sliding it back and forth on a grinder table or on a suitable block on which shoulder *E* has a good bearing and using a square, the exact angle will be quickly ascertained and the locating holes in *C* may be drilled and reamed. As will be seen, almost any angle may be ground by merely placing more holes in *C* for plug *D*.

The thread tool is made of ¼-inch drill rod with a flat on top by which set screws in both tools always keep the cutting points in the same relative position.

Buffalo, N. Y. A. DANE.

Repairing a Corliss Cylinder Break-down

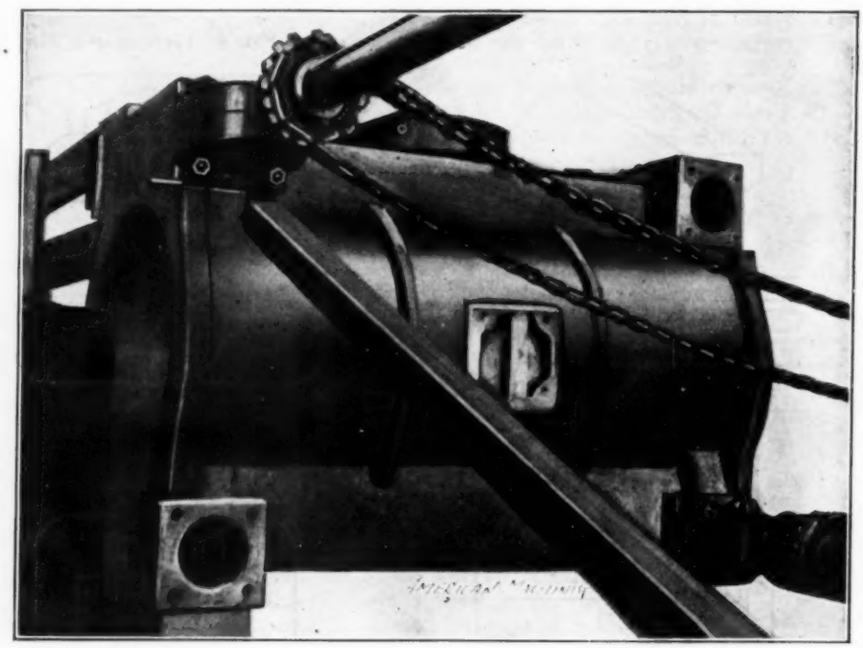
Knowing that all large jobs done in shops not equipped for such work and done at a disadvantage, make interesting reading, I will give an account of a 26x48-inch Corliss cylinder which was wrecked by the piston rod breaking and carrying away back flange and part of valve chambers. The engine was used in a large sawmill and about 800 men were left idle until the cylinder was repaired.

The cylinder broke Saturday noon. A man was at once sent out and a sketch made which arrived Sunday. The patternmakers finished the pattern Tuesday and the cylinder was cast Thursday morning, a special heat being taken off.

The casting was delivered to machine shop Friday morning and cylinder was bored on a 40-inch lathe, raised on blocks to 50 inches. Not having a planer large enough to plane cylinder, it was put on an 8-foot boring mill and flanges and tops of valve chambers faced off. We then put it in a 40-inch planer and planed off the ends of the valve chambers. The holes were all laid off and drilled. It was then put on the floor in front of a 36-inch lathe and valve chambers bored; two boring bars being used at once and bars carried in special castings which were made and drilled the same as the valve bonnets. These can be seen in the picture; also the driving device used, which consisted of sprockets and chain driven from the 36-inch lathe, which gave a positive drive that needed no lining up, as would have been required if belts had been used. The four valve chambers were bored in 24 hours, the bars being fed by a 12-pitch screw.

The cylinder was finished and shipped in six days after it reached the machine shop; was put in the mill Thursday and the plant started Friday morning, which I believe is a good record for such a job. Of course, it was worked night and day. It has been running now six months. One picture shows where cylinder was broken, also the piston rod which caused all the trouble.

Spokane, Wash. JAS. H. FAIRBORN.



EMERGENCY RIG FOR BORING CORLISS VALVE CHAMBERS

Discussion of the Previous Question

Letters from Our Readers Showing how many Men of many Minds Look upon Various Subjects Opened up in previous Numbers

Patterns for Small Belt Pulleys

On page 706, Vol. 32, Part 2, is described a method of making a small belt-pulley pattern, using an iron rim and wood for the web and boss and claiming that the resultant pattern was cheaper and better than a pattern built with wood segments. Any of the methods illustrated in the accompanying figures, all of them old and well tried friends, are in my opinion, preferable, either for casting an iron pattern or for making a few castings.

Fig. 1 is a solid, round block of wood *a*, with a print *b* on each end. The block may be composed of several pieces if necessary. The web and boss of the required casting are shown dotted. In Fig. 2, *c* is the pin board and *d* is the strickle for the cores, two being required for each casting. If a standard iron pattern is desired, allowance can be made for turning all over but if only a few castings are required the wood pattern and cores are used throughout.

Figs. 3 and 4 show a larger pulley or drum pattern, the dotted lines again indicating the internal form of the casting. This pattern is lagged up, cylinder or barrel fashion, with staves and stiffeners and with a print on each end. Figs. 5 and 6 show the pin board *e*, the strickle *f*, and one-half of the webs, spokes and boss *g*, with print for central core.

Fig. 7 shows how pulley patterns are made in plaster of paris, *h* is a board with a wooden mandrel *l*, of a suitable hight to carry the strickle board *m*, attached to it. The strickle is cut to the outline of the under side of the pattern and the block *n* swept up in plaster. A few nails driven into the board and left projecting, will hold it firmly. The strickle is then altered to the outline of the top side, the plaster block given a coat or two of varnish and when dry thoroughly coated with oil. This helps the pattern which is now swept on, from adhering. To make a very clean job cut a piece of sheet zinc to the outline of the pattern; screw in position on the strickle and cut the wood back about an eighth of an inch from the edge of the zinc.

Edinburgh, Scotland. H. PATSON.

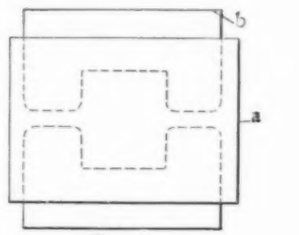


FIG. 1

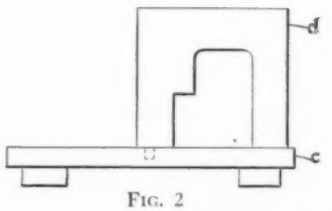


FIG. 2

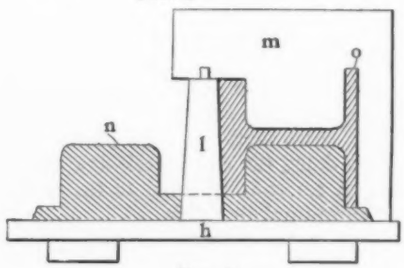


FIG. 7

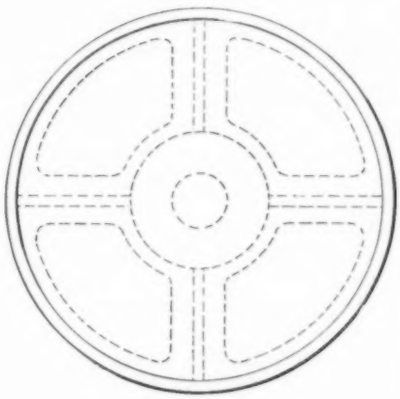


FIG. 3

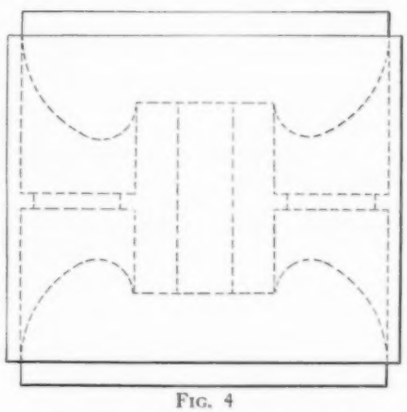


FIG. 4

PATTERNS FOR SMALL BELT PULLEYS

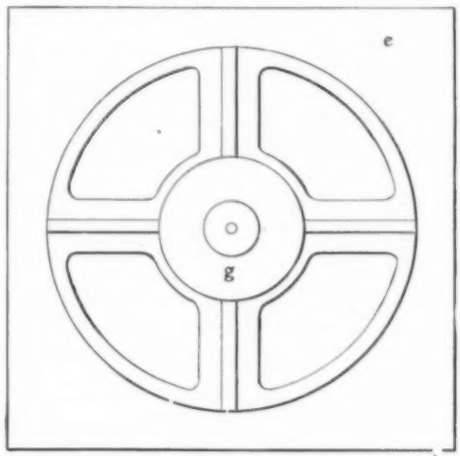


FIG. 5

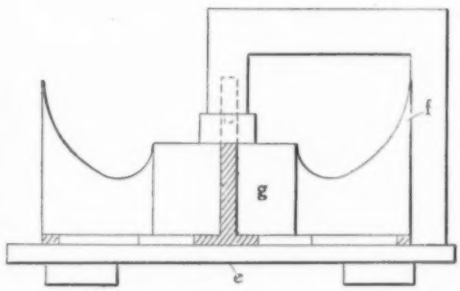


FIG. 6

American Machinist

Twist Drills and Their Tangs

I have read with considerable interest Robert Brown's article on page 84, Volume 32, No. 2, about twist drills and their tangs, and according to my own experience, just as long as taper shanks are used on twist drills or reamers, tangs will be twisted off and tang slots gouged out.

Suppose the average drill-press man takes a twist drill, say, 1½ inches, which has a No. 4 Morse taper and inserts it in the socket of the drill spindle and the taper is an accurate fit. He will start the drill, then raise it and see if it

is cutting central with the laying out. He will repeat this until he is satisfied, but he has no means of knowing whether the spindle is directly in line with the cutting edge of the drill or a little to one side. Nine times out of ten it will be to one side, and if the hole is to be drilled 4 or 5 inches deep, something must give.

According to my own experience it will loosen at the shank and, owing to lost motion in the feed mechanism which is in nearly every machine after a few months use, the spindle will raise a little and the tang must give, or the tank slot in the spindle will be gouged out a little or some of both.

How many readers of the AMERICAN MACHINIST ever saw tangs twisted off milling-machine arbors? Probably not one out of a thousand and, simply because the outer end of the arbor is well supported and has no chance to wabble. There is also another reason for tangs being twisted off and slots being gouged out. When the operator drives one socket over another with a hammer or bangs the sockets down on the drill-press table or on some other hard surface, it makes an umbrella head on the end of the tang which keeps it from being properly seated.

I have overcome that by furnishing the drill-press men with a cast-iron cup filled with zinc, which is good for both ends of the drill.

Janesville, Wis. J. A. RAUGLET.

European Pyrometers

With reference to my article on the above subject, published at page 308, I desire to add, to remove possible misconstruction, that while the instruments I described are mainly of European origin, they are now nearly all being manufactured in the United States.

Rochester, N. Y. CHARLES E. FOSTER.

Two Motors and One Lineshaft

That "little two-horse motor" shown at page 157 was, no doubt, doing a lot of useful work, but doing it under difficulties and was needlessly compelled to expend a lot of its energy in overcoming useless friction. It was driving through a lineshaft with its bearings and loose pulleys. It is also probable that when it was first found that the power delivery was short, the belts were shortened up and tightened up.

Quite likely all of one-third and possibly even over one-half of the power of that motor was used up in friction on line-shaft and countershafts.

Now, the real remedy was to get more useful power by cutting out the intermediate waste, by the simple substitution of ball bearings for the plain bearings. That would probably have cost less in the first place than the new extra motor and it would have kept on costing less every day and all day. The new extra motor provided extra power to use up in lineshaft friction and that power waste has to be paid for every day and all day.

Philadelphia, Penn. HENRY HESS.

The Trade School vs. the Factory School

The article by Mr. Kreutzpointer, on page 66, the one by Mr. Scott on page 76 of the same number, and the one by Mr. Halsey on page 123 of the next number all present one side only of the important question of trade education. That question is largely one of whether the Fitchburg plan or the Worcester plan best meets the needs of employers and employees. My championship of the Worcester plan is nothing new, but I feel that these papers call for a statement on the other side.

The principal feature of the Fitchburg plan is its apparent low cost. On the surface this is less than zero by the amount of the wages paid the boy. The real cost is covered up so that it is difficult or even impossible to find out what it is. The cost for each pair of pupils who attend the high school alternate weeks cannot be less than the usual cost of a single pupil regularly attending the school. This averages in different parts of New England about $60 per year. The cost in the shop is so covered up in the mass of shop costs that it is impossible to say whether the wages paid the boy are over-earned or whether they are not justified by the circumstances.

I ran a shop similar to the average of the Fitchburg shops for quite a number of years. I took probably 40 or 50 apprentices, one time or another, and I never knew for a positive fact whether they earned their way. I took them because some man in the shop wanted to get in his son or the son of some friend. I rather suspect that some of them paid from the start and I also rather believe that we came out whole on all of them in the end. We paid 7½, 10 and 12½ cents per hour, which is not far below the Fitchburg scale. The actual cost of instructing these boys was also covered up in the shop costs. I do not recollect ever seeing a time card with any reference to showing an apprentice how to do anything. Of course, my men stopped their own work to show the boys quite a bit, which really ought to have been put down as a separate item but never was. The foreman usually assigned each apprentice to some workman, shifting them about as circumstances demanded. The boy stayed most with some rather slow, easy-going man because the others did not want him. The consequence was that our boys became much like the men they worked for, rather slow and easy going. After they finished their apprenticeship some of them went into shops where they got away from their old surroundings and they got over their leisurely ways.

POSSIBLE TO RUN A SHOP ON APPRENTICE LABOR

I believe that a shop could be run entirely on apprentice labor, that is with experienced men to steer but not to work at lathe or bench, and come out even if not make a little money. It would have to be in the hands of mechanics rather than pedagogues, but that is a condition that no one will controvert. That shop would pay the boys wages and thus be able to hold them even if the work was not entirely congenial. It would also keep each boy on work that he had done well long enough so that he would be able to earn his way. If the school shop did not pay wages then some other inducement would have to be held out to keep the boys. One would be superior facilities, one the variety of training and the other, common to both the Fitchburg and Worcester plans, the addition of purely educational features; for America is an education-worshipping country and we all like to have our boys better educated than we were, even though we fear that too much "education as she is educated" in worse than too little.

SUCCESS OF PRIVATE SCHOOLS

There is a curious thing about education. All over the country there are private educational institutions jammed to the doors with pupils, who pay good tuition, and those schools are paying dividends. Also there are semi-public institutions doing the same work and always begging someone to come to the rescue and make up their deficit.

What is the reason? Nothing but a purely business one. One school is run to make money, the other to spend it. Our shops are run to make money. A school shop can be run on business principles just as well as any other shop, except that if it cannot pay wages to the boys it must probably spend more money than the wages amount to in keeping the boys interested.

If books were kept so as to show the truth I do not believe that there would be any perceptible difference in the cost of the Fitchburg plan and the Worcester plan. There is a difference in the people who apparently bear the burden. In either case the school-room cost is to be borne by the community.

COMPARISON OF WORCESTER AND FITCHBURG PLANS

In Fitchburg the cost of shop and

equipment is borne by the individual manufacturers, in Worcester by the city.

In Fitchburg the cost of teaching the apprentice, in the shop, if there is any cost, is borne by the manufacturer, in Worcester by the city and State equally. The point which I wish to make is that this shop cost of an apprentice should be hardly any different in Worcester from that in Fitchburg. We will see that if a boy is set to work in Fitchburg and another in Worcester, and the boys are alike, which is not impossible, if each is put to work on a 16-inch Reed lathe, which is possible, and each is given the same work to do, there is no reason why one boy should not accomplish exactly as much as the other. If one does more than the other it simply shows that he has had better instruction. Since the teachers in both cases are shop-trained, practical men there is no reason why the systems should not be able to get equally good instructors. In both cases half the time of the boy is given to shop work, in Worcester at the rate of 20 to 24 hours per week for 4 years and in Fitchburg for 28 hours per week for 3 years, so there is practically no difference in the amount of time given by the boy. Now where can there be any difference in the results of the two systems?

First, there is the question of wages. Worcester pays nothing, in money, but gives the boy the advantage of personal contact with men whose duty, desire and pleasure is to help them become skilled men of whom the school shall be proud. Second, there is the question of profit. Fitchburg pays her foremen to get out work cheaply as well as accurately. These foremen being paid for results, will get them to the neglect of the boys. Once the new has worn off, the foremen will turn, or have already turned, the boys over to their workmen with the same result that I found as related above. Such training is very like the blind leading the blind, for if the workman had the thorough knowledge of his trade that would fit him to transmit it to another, he would have been promoted to a foremanship himself. Even in Worcester, where they began their search for instructors among the men at the bench they wound up by picking an entire crew of men who had been foremen or superintendents.

I fail to see any reason why the Worcester school should not cost as little per pupil as the Fitchburg school, only the cost in Worcester will be made public and in Fitchburg it will be hidden in a mass of other matter so that it will not appear on the surface. Take the instructor in the Fitchburg school alone, if his salary is less than $1500 he can get more somewhere else, and, assuming that salary with 42 enrolled, that is $35 of heat, light, housing, books, etc., cannot very well be less than this, but these items all go into the general school expense and are easily lost sight of, but the taxpayer pays for it just the same.

In Worcester the cost of this part of the boy's education will be practically the same, but it will appear as a part of the expense of the trade school. The cost of running the shop in Worcester as compared with the cost in each of the many shops in Fitchburg is something that will never be known, because the latter is not a public affair and because it is impossible for a man who has the responsibility of an apprentice to make any satisfactory division of his time account between actual work and helping the boy. Whether it is known or not the only thing that I can see that would make the shop cost greater in Worcester is the fact that they cannot pay their boys for that work which they do. This may sound contradictory, but as a matter of fact and experience cheap labor is apt to be most expensive. On the other hand the very fact that the Worcester boy is not paid for his work necessitates his being given variety and kept progressing steadily forward, which will make for a better training.

The factor of all others that I believe makes it improbable that the Fitchburg plan can have a permanent success, is the fact that a good executive mind and a good teaching mind seldom occur in the same person. It occurs occasionally but very rarely. Now, if a shop is to pay dividends it must have good executives for its foremen and gang bosses. Therefore, the chances of getting bosses who are good teachers is small.

One man, an earnest advocate of the Fitchburg plan, told me the other day that his foremen were all expert teachers, that their principal work was not the looking after men who knew what they were doing but breaking in green men to do various parts of the work. He claimed that his foreman could take a man off the streets and in three months make an expert lathe hand out of him. The next man that I met ran a shop of about the same size, but he told me that the first man was filling me up with hot air.

Apprentice Education Like Experimental Work

This matter of apprentice education is very much like experimental work, it won't mix with making money. A shop that can afford to do experimental work on its own account can afford equally well to run an apprentice department and it takes a pretty good sized shop to do either and make it profitable; 200 men would be the lower limit in my opinion. A shop of that size has no need to appeal to the city or State for support of an apprenticeship school of sufficient size to take care of its own needs. If it is practically the only industry of its kind in the city, then the community need not support a trade school for that trade. Of course, it will turn out boys fitted only for its own consumption which is not likely to mean strictly all-around men. The fact that one large concern does run a training room like that of Brown & Sharpe, F. E. Reed Company, or in a little more scholastic form, the General Electric Company, at Lynn, is not enough to debar the small manufacturer from wanting a trade school to teach his line of work, nor enough to prevent the people from also wanting it.

The trend of modern industry has been from the little shop toward the big shop with the result that while we have some shops big enough to run their own training school, we have very few small enough to allow the old personal contact between master and boy that made the success of the old apprenticeship system. These intermediate size shops with from 25 to 200 hands are really the meat of the industries of the country and they are the ones that are suffering, through no fault of their own, for lack of good workmen. The larger industries may be suffering, but they have only themselves to blame, and they can if they wish use largely specialists whom they can break in in a short space of time, but who are worth little or nothing if they leave the parent shop.

Moderate Sized Shops Need Trade Schools

The moderate-sized shops need the trade schools and the communities in which they are located need them. If the community has half a dozen shops each with say 50 men, none of them could afford to run special training rooms. All combining together could afford to do it. It is contrary to human nature to find six shops that could agree as to the training of a workman well enough to make that kind of coöperation possible unless they simply put the thing out of their individual hands into those of a board of trustees or a separate corporation. What is more natural then, than that the community should take the work on themselves since they are individually interested in having their boys educated in trade lines.

The next step is to have the community insist that the boys should have some facilities for purely cultural education beside the actual practice of their trade, then you have the Worcester plan in full bloom. I consider the cultural part of the plan the least important and the most likely to give the boy hopes and ambitions beyond the possibility of attainment.

Detrimental Influence of Public School Teachers

It is a curious commentary on the American school system that a boy will believe that the advice of his $600 a year school teacher is sure to land him in a $6000 job, never thinking that along with some of our other gold-brick artists she

would take her own advice and earn the $6000 herself if she knew enough to do it. It is the unfortunate fact that boys are constantly being led away from the shops toward already over-crowded professions and toward "business" positions, merely through fear of the scorn of school teachers who look down on people who cannot talk Greek and Latin.

This very danger is one of the striking ones of the Cincinnati or Fitchburg plans. In either of the two cases the boys are sent into public schools to meet pupils and teachers, no matter how little, who will inevitably look down on them as "greasy mechanics" which view has been so bred in the bone of the pedagogical paternity for so long that it never will come out. The effect of taking a boy in the shop and associating him with people who look down on him is simply a matter of discouragement or inflation and either one will remove the boy from the shop.

Worcester Scheme Can Be Applied to other Trades

I fail to see any reason why the Worcester plan is not applicable to other trades than that of machinist. In fact I believe that the machinist's trade is the hardest to teach in that way and the most expensive to equip. The building trades will respond readily to such treatment. The rougher parts of the carpenter's trade, the framing of a house for example, are so easily learned and require so little experience and can be so easily imprinted on the pupil's mind over the drawing board that it would likely be sufficient to have each class of a dozen boys set up a small frame, knocking it down and leaving the studding, etc., ready for the next class to cut and set up for a slightly smaller building. The really difficult work of a carpenter is all done inside and can be as well done in a school shop as in a building under construction.

Bricklaying can be taught under cover provided there is a room high enough so that boys can learn to lay from a stage. Bricks can be laid 6 or 8 times before being thrown away. The objection to existing trade schools in the building line is that the courses are so short that it is impossible that the graduates should have sufficient experience as they go along to make their work profitable to themselves.

If a community establishes a school for the teaching of any one trade it necessarily follows that they will have to establish other schools for the teaching of all trades which are extensively practiced in that community. Otherwise injustice is done to the taxpayers. Under Massachussetts laws boys can be sent to schools outside their immediate community upon payment by their home town of the cost of maintenance which rules in the school to which they are sent, and draw back from the State one-half that cost just as if they had gone to the expense of establishing and equipping a school.

Political and Public Sentiment

As for the uncertainty of public sentiment, the illustration of manual training is a most fortunate one for my contentions, for as a rule public sentiment and political sentiment have dealt most leniently with it considering how little real returns the vast amount of money spent on it has brought. If there is a thing which ought to be disciplined it is our manual training methods. The idea is all right, but the domination of the school by the professional pedagogue has ruined its practical value. It is, of course, true that politics may take a hand in any public affair but if it does it is usually because someone interested in the affair has interested politics in it. Even then, if the thing is something of real worth, undue political influence is quickly condemned at the polls.

Springfield, Mass. Entropy.

Cutting Skew Bevel Gears

An article by J. A. Utts in the American Machinist, page 314, Volume 32, Part 1, reminds me of a much simpler method used to cut skew bevel gears on a Gleason planing machine.

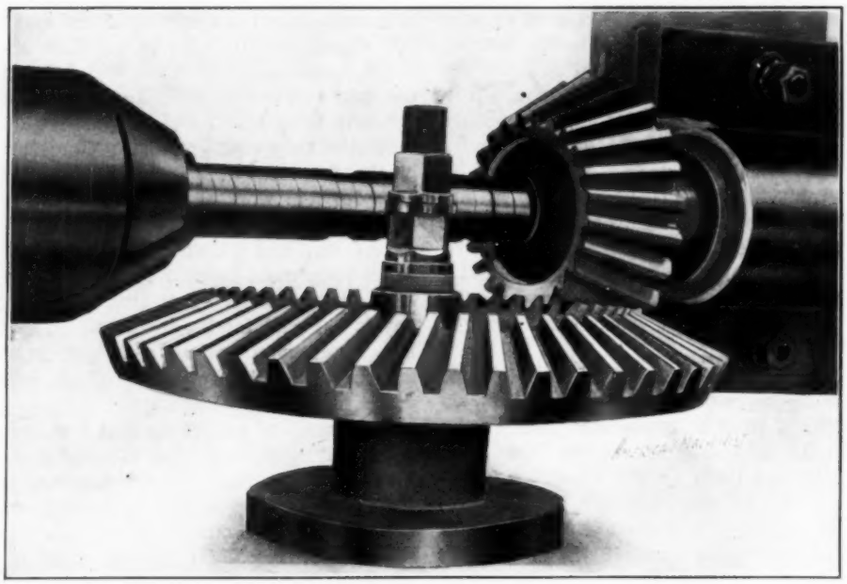


Fig. 1. Skew Bevel Gears

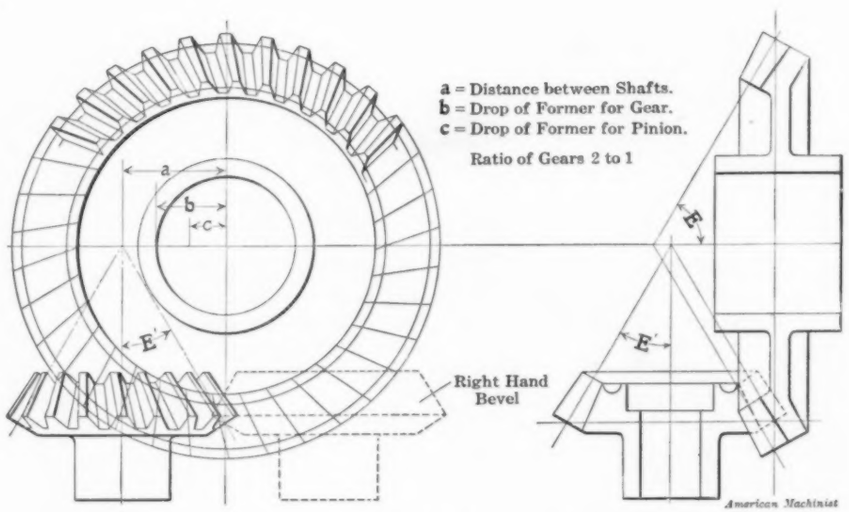


Fig. 2. Layout for Skew Bevel Gears

The gears are turned up according to bevel gears of the same number of teeth, pitch and ratio, no alteration being made in the diameters or angles due to the fact that the apex points of the two gears do not intersect.

The teeth are cut diagonally across the face in a straight path, the gear being held stationary while each tooth is cut.

This diagonal cut is accomplished by dropping the former a proportional space of the distance between the shaft centers. Thus, when cutting miter gears with 2 inches between the shafts, the former would be dropped 1 inch in each case. For a gear ratio of two to one and the same shaft centers the former would be dropped $\frac{2}{2+1} = 0.666$ inch for the pinion and $0.666 \times 2 = 1.333$ inch drop for the gear. It is not at all necessary that this drop in the former be so divided; it may all be put in either gear of a pair. But if it is evenly divided in proportion to the number of teeth or ratio of each gear the contact will be better and less trouble will be experienced in cutting the teeth.

Dropping the former produces a left-hand tooth, and raising the former produces a right-hand tooth. Lowering the former when cutting the gear and raising the former for the pinion will produce a left-hand gear and a right-hand pinion which will run together, the only difference being that the pinion will turn the gear in the opposite direction, being located in the right-hand side instead of the left-hand side as shown by dotted lines in Fig. 2.

The former must be inclined to the same angle as that used for cutting the teeth or the teeth will lean. The gears illustrated in halftone Fig. 1 were 1½-inch circular pitch, 4½-inch face, the larger being approximately 36 inches pitch diameter. The distance between the shaft centers was 3 9/16 inches. These gears operated with the usual amount of backlash, there being even contact the entire length of the tooth. Many smaller gears have been cut in the same manner, all of which have been entirely satisfactory.

By this method the skew bevel gear, which has long been avoided as being next-to-impossible of solution, is made a commercial possibility. These gears, Fig. 1, were made by the R. D. Nuttall Company, of Pittsburg, Penn.

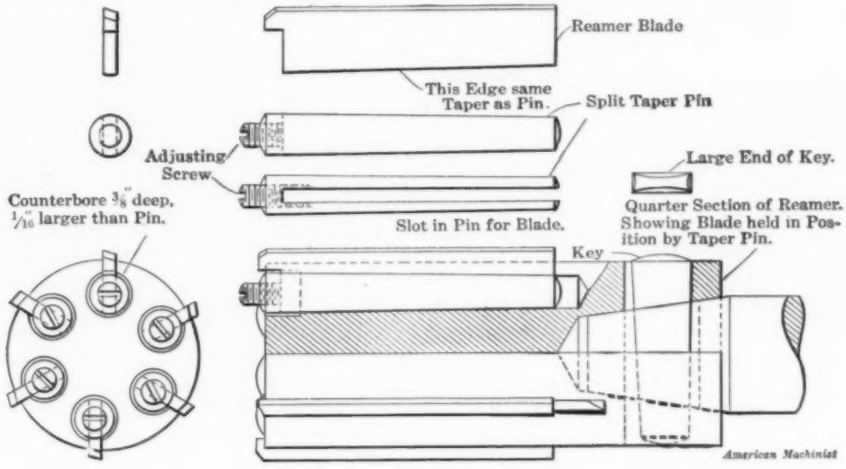
Pittsburg, Penn. CHAS. H. LOGUE.

An Expanding Reamer

Your correspondent E. D. H., shows on page 173, an idea of an expanding reamer that will not expand, but will, to follow his instructions, become elongated by grinding the blades as directed. The line *B B*, being parallel with the axes, it seems to me, would prevent the blades from expanding, by grinding off from the bottom of the blade. However, if I am wrong I would like information as to how this can be done.

I inclose sketch of an expanding reamer that in my opinion will expand, and trust some of the readers of the AMERICAN MACHINIST will be benefited by it. The sketch will show the construction.

Holyoke, Mass. C. W. PUTNAM.


Reamer Blade
This Edge same Taper as Pin.
Split Taper Pin
Adjusting Screw
Large End of Key.
Counterbore 3/8" deep, 1/16" larger than Pin.
Slot in Pin for Blade.
Quarter Section of Reamer. Showing Blade held in Position by Taper Pin.
Key
American Machinist

A 1⅝-INCH EXPANDING REAMER

Dies for Forming Tubes

On page 1099, Volume 32, Part 2, was given a letter by P. P. Monfils answering A. B. Card, who at page 839 asks for suggestions for forming tubes as per sketch on the latter page. If it is necessary for the article to be 0.020 inch in thickness when finished, would not the better way be to start with a blank 0.010 inch thicker and draw the tube to the size required? It is working to fine limits to draw a piece 5 times and keep the thickness the same.

Again I would like to ask P. P. Monfils how he proposes to prevent buckling, which is sure to take place in drawing a blank of 4 inches diameter down to 2½ inches in one operation, especially with a punch having corners almost square, as in his sketch. I think the better way would be to make an extra operation, the first cupping to be as in Fig. 1, herewith.

As regards stripping the work; it is not a very safe plan to depend upon the die for pulling it off the punch, as 40 per cent. of the pieces would pull back through the die and if steel were used, 75 per cent. I think the best method of stripping is as follows.

Turn a tool-steel washer about 0.0250 inch thick, with internal diameter same as the die. Turn a groove around the outside, deep enough to take a 3/16-inch diameter coiled spring; saw into halves and harden.

Put in the back of the die to take the shock with sufficient clearance to allow the two halves to open (Fig. 2) and close when the die is strapped in the bolster. Set the press so that the punch will carry the cup through the washer, which at once closes on the punch and strips the cup as the press goes up.

FIG. 1. FIRST CUPPING STEP IN FORMING TUBE

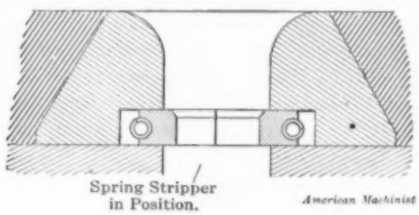


FIG. 2. TUBE DIE WITH AUTOMATIC STRIPPER

The climax is reached in the letter when P. P. Monfils states that an operator can turn out 10,000 *gross* in 10 working hours. Has he thought what this means? In the first place, the piece does not lend itself to be fed automatically, on account of its size and shape (excepting the blanking), but if it did and an operator had 6 presses, he could not turn out half the quantity. A single press would have to be used for the job and to get the output stated it would have to make 2400 revolutions per minute; the speed of an ordinary emery wheel. H. D. COVENTRY.

The new 14-inch gun under construction at the Washington navy yard for the new battleships is designed to have some extremely important improvements. The gun is to have a range of more than 25 miles, and it is figured that the shell will leave the muzzle at a rate of 2000 feet per second. The penetrative power of this gun has been increased so that at a distance of 3000 yards the shot will pierce Krupp armor plate 18½ inches thick. It takes a full charge of 365 pounds of powder, weighs 63½ tons, and will fire a projectile weighing 1400 pounds.

Opening the Worcester Trade School

By E. H. Fish

The Worcester Trade School was formally dedicated February 18 and opened, with some 50 pupils in attendance, on the following morning. At the same time formal announcement of its purpose and methods was made to the public.

While much of the matter contained in the announcement is familiar to your readers and more is of purely local interest, there are a few items of general interest. One is the relation between this school and the public-school system, which you lightly touched upon in your editorial on page 1153, Volume 32, Part 2. The school has been built and equipped and its policy established by a board of 13 trustees, six of whom were elected at large by the city council and three by the school committee of the city from their own number. The remaining four are the presidents of the two boards of the city council, the chairman of the committee on education of the city council and the chairman of the school committee acting ex-officio. This has given the school committee four out of 13 votes, which have not, however, been used to noticeably influence the direct connection between the public schools and this independent school. I should say that by both State law and city ordinance these schools are made "independent," but in other cities in the State the boards of trustees have been selected from the members of the school committee, thus dodging the law as neatly as the holding companies dodge the corporation trust laws.

No Connection with Public Schools

Here, we are working in the opposite direction. The mayor has just signed a new ordinance which does away with all the ex-officio members and all the school committee members. Of course, it would be possible for the city council to elect as many school committee members as they please but our new board contains only one such member.

The nearest connection that the trade school will have to the public schools is in the admission of pupils. We are to take pupils who have passed the entrance examinations for the high school, who show mechanical ability and are in fit physical condition, without examination. Others, who have not advanced so far in school are not barred, but will be admitted on examination. Mechanical ability will be judged from past work that the boys may have done in the limited amount of manual training that they have had or work that they may have done at home or in vacations.

Both Iron and Wood Work To Be Done

Classes will be formed in both iron work and wood work. Iron work will not be limited, as some readers of the American Machinist have thought, to the repair of the second-hand machinery. For a starter many firms in and out of Worcester have volunteered to furnish quantities of small machine parts, which can be made to gage, or to micrometers, and which they keep in stock so that we may not be crowded to get them out. We will select from these shops jobs which do not need to be made closely to size and give them to boys with instructions to keep as close to actual size as possible. For example, a stud on which a variation of 0.005 inch small would be allowable will be given to the boy with 0.001 inch limit. In this way we can get work to do which will train the boy in accurate work and yet make it unlikely that any considerable amount will be spoiled.

Again, we have a long list of small stuff; jacks, parallels, knees, angles, planer vises, vise screws, etc., which are stock items on dealers' shelves which we can make up for sale, and which can be made as well as we can get them made and yet some of them are salable if not made to the uttermost limit. All this work will be sold or paid for at the manufacturers actual cost to make in his own shop, they furnishing the materials.

When I say that John Back, so well-known to your readers as the shop man of the F. E. Reed Company, is to be in charge of this department, those of them who also remember me as a lathe builder will likely wonder if something new in the lathe line will be forthcoming. We do not intend going on the market with anything in which we will compete with people already in business in the State, nor do we feel that is it a necessary function of a trade school to originate anything. We feel that it is our duty to turn out machinists rather than designers.

Nevertheless the designing instinct may get the better of us and after the comet has safely passed and the excitement over Tillinghast's flying machine has died out, we may possibly get out a lathe, not for the market but because we need more to complete our equipment.

The Tool Equipment

Speaking of equipment, the distance that we have traveled from public school manual training may be judged from this list: Lathes: One 14-inch, seven 16-inch, one 18-inch, one 20-inch, one 2x24 flat turret. Planers: Two 24-inch by 10-foot, one 30-inch by 10-foot, one 16-inch shaper. Millers: One No. 1½ plain, two No. 1½ universal, one No. 13 gear cutter. Grinders: One tool and cutter grinder, one 10x50-inch plain grinder, one No. 1 universal grinder, 1 drill grinder. Drills: Two sensitive, one 20-inch, one 25-inch.

There is also a cutting-off saw, a centering machine, a gas furnace, etc.

The woodworking department has an 18-inch jointer, a 24-inch pony planer, a band saw, two circular saws, a pattern lathe, and six speed lathes. This equipment is of a sufficiently heavy nature so that work of real importance can be undertaken.

Instructors Are Practical Men

All our instructors are practical workmen, without previous experience in teaching. This radical departure has the unanimous approval of our board of trustees, but will undoubtedly be watched with considerable interest. My own experience in teaching has impressed me with the belief that in practical matters the value of pedagogical training is easily overestimated. A real knowledge of what one is teaching, a persistent refusal to show temper and a faculty of making oneself understood seem to me to be more important essentials than any special training or college degree. Those of us who have degrees are going to conceal the fact so far as possible. Between us we have two centuries of shop experience, ranging from 12 to 40 years individually.

We are in no way antagonistis to established methods of education. We simply feel that we are entering upon a work of which the professional educator can hardly be expected to be a master; a line distinctly practical and not one that should be attacked from a theoretical or scientific side. We recognize the public schools as intended, first, last and always as preparatory to college training and we recognize college and technical schools as intended to train professional men, and we believe that our position should be, as it is by law, "independent" of both.

Because we do recognize our duty to train boys for a trade does not prevent our feeling that a well trained boy has future possibilities in our industries that are limited only by his natural talents. Because we may train him to build machinery, when the Polytechnic Institute may train him to design is not putting a limitation on his future, it is only steering him in another course, possibly longer but we believe safer.

No Text Books at First

The very fact that our teaching force is made up of men without the traditions of professional educators is our best insurance against evolving into a third-rate technical school. Even our class-room work is to be conducted by means of texts which we will work out as we go along, there being no books which fully

meet our needs, those coming from educators being either impractical or uninteresting, those from the purely shop men too scarce and too crudely thought out. Our ideal of text books is a book of problems following each other in so logical a sequence and advancing so regularly and gradually that the passage from one to another will require but the minimum of explanatory matter.

The First Class of Boys

Following the formal dedication we opened the school at 8 a.m., February 9, with 50 boys in attendance, 24 taking woodwork and 26 iron. These boys are as it happens an extremely bright crowd. The really correct way to select these pupils would perhaps have been to set up an examination and admit only those who were above a certain mark and below a certain other grade. As it was, we encouraged every boy whom we thought fitted for technical training to go to a technical school. After doing that we felt that we were justified in taking the boys as they came.

They are well distributed as regards nationality. The majority are Yankees, Irish next, then Swedes and a scattering of others. They come from all sections of the city. They are not the sons of either the rich nor the very poor but of a middle class.

For that matter we have very few of the really poor in Worcester, as compared with many of the greater cities. By this I mean that there are relatively few families where meat is not on the table at least once a day and where each member of the family cannot boast a "Sunday suit" of clothes.

Our boys are in the main boys who appear to be well fed and healthy. Many of them have not been over responsive to their school training. In the examination given to nongraduates of the grammar schools, we gave as one problem to find the area of a board 18 inches wide at one end and 6 inches wide at the other and 10 feet 4 inches long. We found answers running from 3 to over 5000 square feet. Of course, this indicated what we already suspected, that the boys had learned rules which they readily forgot under pressure rather than principles which they never could forget. We also gave the commonest, easiest problem in triangles, given a right triangle, one side 8 feet, the hypotenuse 10 feet long to find the short side. We had many answers over 10 feet, yet they all showed that they had heard something about the relation between the square of the sides.

The Boys' First Work

We put the boys directly to work and within half an hour after the opening of the school they were producing—chips, at least. Through the courtesy of the Union Twist Drill Company, we had on hand something like 1500 drill blanks to be turned to micrometers and tapered on the shanks to gages. We had the lathes all rigged for the work so that a few minutes' explanation started them going.

We expect to keep them at this work simply doing what they are told until they get over their first stage fright and get used to their surroundings and learn to measure and to work to micrometers. The shaper was ready for a boy to start roughing out planer parallels as was also one of the milling machines. Other lathes were set up to turn plugs for the planers, and the millers rigged to mill them square, not that it is essential that they be square, but because it is a good job of milling and the material costs us nothing, because we have to buy it for the making of the plugs. These also give us a good job of drilling and tapping.

Our planer bolts will also be lathe turned and the thread cut in the lathe and possibly the heads milled. We have plenty of other work of a similar nature in view. Later we may report something in the way of machinery under construction or reconstruction but at present we expect to do job work and manufacture equipment. This actual shop work covers half the week's time of 44 hours per week.

The other half, originally intended to be devoted entirely to book work, has been trespassed on to the extent of 2 hours for drafting and 6 hours per week for "shop instruction."

Shop Instruction

This latter is a rather unique feature. Recognizing the remarkable progress made in technical school shops in the all too brief time devoted to shop work we feel that their methods are entitled to our respectful consideration even though we wish to keep them very separate from our main efforts. We are, therefore, using this 6 hours per week shop instruction to teach the boys the things which underlie what he will be doing another day in the work shop. In this time he will learn to read a micrometer caliper, to lace a belt, to scrape and file and chip, to dismantle and reassemble machinery and to find out how they are put together. In fact it is intended to cover all work and instruction not involving the running of machine tools, to the end that when the boy is in the work shop his efforts may be directed almost entirely to producing work of value.

Arrangement of Classes

Of our class-room work and its relation to the shop I shall have more to say later, though one feature of the program is of interest and that is our idea of entering a class every three months and keeping the boys that distance apart. It will be noted at once that this will make it much easier for us. To break in only one quarter of our first-year boys at a time will be a considerable relief. We do not expect to make a regular thing of having one boy teach another but in the future we expect one boy to help initiate another who may be perhaps two years behind him. It is, of course, apparent that differences in capacities between the various boys will break out at once. Some advanced further the first day than others will in a week. Our interest is to make the boy's instruction very individual. This will require more instructors, but we believe will make possible enough more production to more than pay for the extra salaries.

It is the one case that has come to our attention where increased expense in educational work may mean diminished total expense and increased efficiency at the same time.

A New Non-rusting Ingot Iron

A new iron has been placed on the market that will withstand corrosion much better than the ordinary grade, for use in such places as in the ground where it is attacked by dampness; in localities where it becomes the intermittent conductor of electrical currents; at the seashore where it is attacked by salt air, or in cities where the atmosphere is impregnated by fumes of gas and coal smoke. This iron is made as nearly pure as possible from the theory that it is the impurities in iron that cause corrosive agents to attack it; this has been named ingot iron. Comparative test between mild steel and this new ingot iron that was made by the metallurgical professor of the Ohio State University, Columbus, Ohio, shows that the analysis of commercial steel was: Sulphur 0.048 per cent., phosphorus 0.094 per cent., carbon 0.11 per cent., manganese 0.47 per cent., silicon a trace; while the new ingot iron analyzed, sulphur 0.005 per cent., phosphorus 0.005 per cent., carbon 0.021 per cent., manganese and silicon a trace. The strength of the new ingot iron was: Breaking strain from 49,857 to 51,905 pounds per square inch, elastic limit from 35,395 to 41,377 pounds per square inch and elongation 40 to 48 per cent.

Corrosive tests were carried on with a 25 per cent. sulphuric acid solution and in six hours an eyebar of the new ingot iron lost 16.5 per cent., while a charcoal iron lost 77.3 per cent. In five hours a railroad spike of the new ingot iron lost 11.2 per cent. and an ordinary steel spike 79.1 per cent. In a 45-minute test of two nails, the common steel wire nail lost 68.9 per cent. and the ingot iron 4.13 per cent.

The iron is manufactured by the American Rolling Mills Company, Middletown, Ohio.

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American Machinist

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The Electric Motor Again

Any discussion of this subject must of necessity travel along well trod paths. Yet, there is apparently need for thus retracing one's steps, for questions like the following are frequently asked: "Why is the electric motor making such slow progress in the machine shop? Why are its advantages so little appreciated? And why do machine-tool manufacturers seem indifferent to pushing motor-driven tools?"

In attempting to point out the reasons for asking these questions as far as the use of the machine tool and the motor are concerned, whether for individual or group drive, we are met by the fact that enthusiastic advocates of the motor have injured the cause in the past by unfortunate arguments or at least by misplaced emphasis. The dollars and cents end of any proposition attracts. Thus the efficiency of motor distribution of power, versus mechanical inefficiency of power transmission, has been a favored theme. The conclusion both inferred and stated has been that electric motors and electric transmission of power in a machine shop were savers of power.

Tests and reports innumerable have been quoted to support this conclusion; yet the machine-shop man who has carefully considered the conditions has been apt to be skeptical. He realizes that surrounding conditions have a tremendous influence on the question, and is not ready to admit or believe off-hand that the electrical proposition is unquestionably more economical than a corresponding uptodate mechanical installation, provided conditions are at all favorable to the latter.

In any event this question is a disputable one, instead of being axiomatic as many would like to have us believe.

Again, such minor arguments as increased cleanliness and healthfulness have been urged in favor of the electric motor. While they have an element of truth, they are hardly important enough to be decisive in any installation.

In many shops a motor is looked upon as a mysterious machine that must be cared for by an electrician; and as another man cannot be added to the payroll just to care for a motor or two, or three, electric driving is not seriously considered. The difficulty of caring for motors has undoubtedly been exaggerated.

Another point to consider is that a machine tool recognizes no quality in power. Its maker knows that it can meet his guarantees, whether electrically or mechanically driven. Give it a sufficient quantity of power and the machine tool will do its work without knowing whether that power came from a pound of coal or a waterfall; whether it is transmitted mechanically or distributed electrically; whether the power reaches it through a belt from a countershaft, or through a gear from a motor.

As there have been misplaced emphasis and unfortunate arguments used in favor of the electric motor, likewise there has been a failure to emphasize properly its greatest advantages in the machine shop. These advantages can be summed up under the broad heading, convenience, with sub-headings, flexibility and utility. These advantages have nothing to do primarily with the machine tool itself, but do have to do with the shop organization. Therefore, the machine-tool manufacturer is at once absolved from any charge of lack of being progressive, as far as his product is concerned, for his work primarily has to do with making machine tools, not with advising the factory organization that is to operate them.

As for the user, he has perhaps not been sufficiently impressed with these advantages—flexibility and utility; nor with the savings that can be made, not in power consumption, but in other elements entering into factory costs. It is not necessary to dwell upon these arguments in detail here, but we can scarcely imagine a large machine-shop installation of today where the electric drive should not be seriously considered, with the probabilities very much in favor of its being adopted.

Prof. D. C. Jackson in a paper presented recently before a meeting of Boston engineers sums up the advantages of flexibility of electrical distribution of power, even in a most advantageous situation for mechanical transmission, as follows:

"Even when water power in large quantities is available directly alongside suitable factory sites the electrical distribution of power may play a part of sufficient importance to enable it to supplant mechanical methods on account of its flexibility, which leaves the mill architect free to arrange his factory building to suit the requirements of manufacturing products, substantially untrammeled by those difficulties which always surround the transmission and distribution of power by mechanical means."

CIRCULATION STATEMENT

During 1909 *we printed and circulated* 1,209,000 *copies of the* AMERICAN MACHINIST.

Our circulation for February, 1910, *was (American weekly, American monthly, English weekly and German weekly)* 109,250.

March 3..... 40,250
March 10..... 23,750

This paper reaches 40,250 *separate readers each month and* 23,750 *each week.*

None sent free regularly, no returns from news companies, no back numbers. Figures are live, net circulation.

Contents

PAGE

A Central Tool Dressing Plant in a Navy Yard 431
Self-Building a Shop on Earnings..... 434
Compression of Lead Cylinders..... 435
A Comprehensive Card System for Blueprints 437
Turret Lathe Equipment for Making Automobile Parts..... 438
Following Up System in an Engine Plant 441
Engraving Machines of Various Kinds... 442
Self Generating Spur Gear Machine of English Design..... 443
Bushings—A Proper Driving Fit..... 446
Two Semi-automatic Milling Machines... 447
A Depth Gage for Small Work..... 448
Testing Power Presses to Find Capacity and Rating..... 449
The Efficiency of Compressed Air..... 452
Some Tools Used to Build the Merkel-Light Motor Cycle.. 453
Sizes of Metric Hand Taps..... 455
The Effect of Manganese in Steel..... 456
One Year's Business without Profit..... 457
Letters from Practical Men:
A Neat Ball Turning Device....The Square Root by "Homemade" Methods....Jigs for Convex and Concave Die Parts....Thread Tool Holder and Grinding Fixture....Repairing a Corliss Cylinder Breakdown...458-460
Discussion of the Previous Question:
Patterns for Small Belt Pulleys....Twist Drills and Their Tangs....Trade vs. Factory School..Cutting Skew Bevel Gears....Expanding Reamer....Dies for Forming Tubes 461-465
Opening the Worcester Trade School.... 466
Electric Motor Again..... 468
Delayed Shipments..... 469
New Tools and Machine Shop Appliances 470

Safety of Oxyacetylene Outfits

In other columns we print an article concerning the explosion of an oxygen generator and oxygen storage tank, forming part of an oxyacetylene welding outfit. One man was instantly killed, another very seriously injured.

It is important to note that the acetylene generator was uninjured. It was not an acetylene explosion. Neither was it the explosion of an isolated tank charged with oxygen at a high pressure, but of an oxygen generator and its accompanying storage tank.

The location of the ruptures indicates that there was no defect in material or structural weakness in either tank or generator.

It is difficult to trace out the cause of the explosion with any degree of certainty. No witnesses of the accident could be examined, and therefore no information was brought out by the coroner's investigation.

As pointed out in our article, a plausible theory is the explosive ignition of some substance in the generator, thereby creating a pressure sufficient to burst both tank and generator.

There has been some tendency to condemn the oxyacetylene process as dangerous. Undoubtedly this accident will be pointed at as proof of the hazards that exist.

Whatever the cause of the accident may have been, and regrettable as are the loss of life and bodily injury, general condemnation of the oxyacetylene process is unjust. The oxyacetylene process of welding and the like is a valuable machine-shop process and is here to stay. It now remains to consider the points of danger and set up safeguards against them.

Steam boilers give us a parallel, in that both they and the oxyacetylene outfits have tanks subjected to internal pressure. Boiler explosions, unfortunately, occur; yet we do not think of discarding or condemning steam boilers as a whole. But we do establish standards for design, provide for adequate inspection and require that they shall be cared for by competent men.

The same principles hold with oxyacetylene apparatus. Manufacturers must know that their designs are right, that their materials are suitable, that the workmanship is of the necessary quality. Purchasers must know such apparatus is in proper working order, is inspected at frequent intervals and is in the hands of competent workmen. And the workmen themselves must exercise due care.

None of these things entails as great a burden upon manufacturer, owner or operator, as does the building, care and operating of a boiler.

As for the apparatus hundreds of acetylene-gas plants are in daily use and are not looked upon as a serious hazard. A parallel to the oxygen-charged cylinder is the carbon-dioxide cylinder used in soda-water fountains. These are not considered dangerous, although one occasionally blows up. As for the oxygen generator, if it is found to be dangerous put it in a masonry vault and pipe the gas to the work.

This latter point, however, needs careful investigation for one of the advantages of the oxyacetylene outfit is its portability.

We repeat—oxyacetylene apparatus is here to stay. A heavy responsibility rests upon both maker and user, for disregard of necessary precautions may result in loss of human life. Yet this responsibility is no greater than that resting on the shoulders of builders and users of many other kinds of apparatus; and we do not doubt but that all directly concerned will fully meet the needs of the situation.

Unfair Responsibility for Delayed Shipments

Builders of standard machines are sometimes accused of being unprogressive because they are slow to adopt accessories built by others or do not jump at a chance to furnish them with the machine. The electric motor drive is an example that comes up most frequently.

To begin with, the machine builder must often design his machine to fit the motor owing to the difficulty of securing anything but standard motors, which are standard from the maker's point of view only. Any departure from this means a long delay and much uncertainty as to delivery.

But assuming that the standard motor meets every requirement, there is still the difficulty of being dependent on another manufacturer, before his own product can be delivered. The machine builder gives a date of delivery for the machine and motor, based on his product and that of the motor builder, and is held responsible by his customer for the whole combination

When delivery is delayed the customer blames the machine builder and is skeptical of excuses about the motor, sometimes not without cause, but in any case the result is unpleasant. More than this it often leads to a cancelation of orders owing to delay, which entails an unwarranted expense on the machine builder.

This is particularly aggravating in the case of a special machine where its rejection means either a complete loss or at best a long delay before effecting a sale. In a recent case of this kind the date of delivery was set two months after the promised delivery of the motor. But the motor did not appear within four months of its promised date of delivery and in the meantime the disgusted customer had canceled the order for the whole outfit.

The only safe way would appear to be that of guaranteeing date of delivery of machine without the motor or other attachment and without responsibility for delay, due to non-delivery of such attachments after machine was ready to receive them.

Until these annoyances and too often, positive losses, are removed or provided for, it is not strange that machine builders are not always anxious to become advocates of motor drives or other progressive attachments.

Good Work in Manufacturing Speed Lathes

Through one of the unaccountable oversights that seem to creep into all editorial work once in a while, the name of the builder of the speed lathes referred to in the article with the above heading which appeared on page 389, was omitted. These methods are from the shop of F. E. Wells & Son Company, Greenfield, Mass., to whom we are indebted for the photographs.

PERSONALS

Items For This Column Are Solicited

L. Lambert has relinquished his position as superintendent of the manufacturing department of the Victor Talking Machine Company, Camden, N. J.

Clifford Talbot, recently in the engineering department of the American Optical Company, Southbridge, Mass., is now in charge of the tool department of J. Cunningham Sons & Co., Rochester, N. Y.

Herren Direktor Fessel and Doktor Jager, of Siemens & Halske Company, Berlin, Germany, are in this country on a tour of inspection of manufacturing methods in certain lines in which they are interested.

W. A. Ten Winkle, for over 5 years publicity manager of the Electric Controller and Manufacturing Company has resigned to become affiliated with the Penton Publishing Company, Cleveland, Ohio, as special representative.

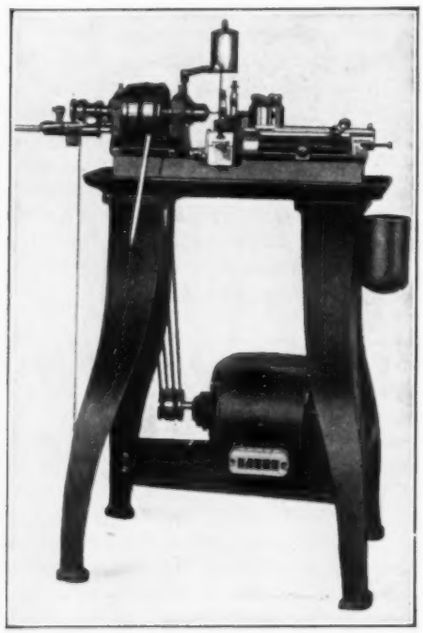
Eph. Smith, who has been the New England sales manager of the Colonial Steel Company for the past nine years, has been obliged to resign his position owing to continued ill health. Mr. Smith is to be succeeded by E. P. Fitzgerald, who has been representing the Boston office of his company for several years.

W. H. Callan, general foreman of the Chicago Pneumatic Tool Company's plant at Franklin, Penn., has accepted the position of superintendent of the Venango Manufacturing Company. On the occasion of his change Mr. Callan was presented with an appropriate token of esteem by his former associates.

New Tools *and* Machine Shop Appliances
Showing New Ideas *in* Machine Shop Equipment *that* make *it* possible *to* do better work at a reduced cost

A Motor Driven Screw Machine

Fig. 1 shows the way the Garvin Machine Company, of New York, applies motor-drive to their No. 00 screw machine. The machine can be reversed immediately by the hand lever shown below the pulley, which shifts the high-speed round belt on to the driving pulley which is secured to the spindle. This pulley is grooved and is larger in diameter than the two loose pulleys on either side. These loose pulleys are crowned to the central or driving pulley so when the belt is run into the driving pulley, it is much tighter than when it is running in the groove at the farthest end of each of the loose pulleys. One cross and one straight belt is used. The capacity of the machine is ¼ inch diameter with the wire feed (as shown) and is suitable for the smallest size of rod work. A standard No. 3 American Watch Tool Company's collet is used. The spindle is hardened and ground. Lightness of working parts gives the requisite sensitiveness for small tools. The machine weighs 500 pounds, including motor.



A Motor-driven Screw Machine

Indexing Mechanism for Turrets

Fig. 2 shows the new indexing mechanism of the Garvin turrets, the operation of which is as follows:

The stop *A* brings the turret to rest before the index pin *D* seats itself. On the return movement of the turret slide the back end of the lock-pin lever *E* rides up and slides along on the tumbler *F*, withdrawing the lock-pin *D* from its seat and holding it out. The star-wheel lever *C* now engages the star-wheel *B*, rotating the turret, and the combined backward movement and partial rotation brings the back of the star-wheel *B* up against the solid stop *A* in the turret base. The momentum of the turret is absorbed on striking the stop pin *A* and the turret and turret slide stand at rest. The turret slide is also provided with an independent end stop. Immediately on the forward motion of the turret slide, the tumbler *F* is toppled over, releasing the lock-pin lever *E* so that the spring *H* seats the locking pin *D* into the bushing *G*, all of which takes place without shock or jar to the indexing mechanism.

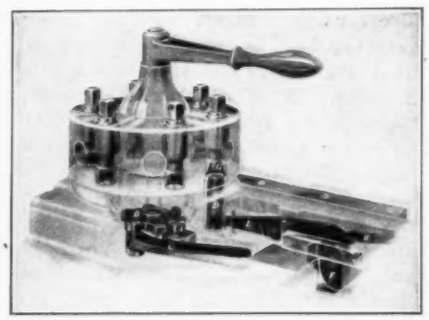


Fig. 2. New Turret Indexing Mechanism

ANY new or improved machine or shop appliance of interest to our readers will be illustrated and described in this department.

A full and more detailed description will be given—when of special interest and it appears here before being sent elsewhere.

ALL descriptions appear in all four editions of the paper—Weekly, Monthly, Weekly English and Weekly German.

Adjustable Flask-Stripping Molding Machine

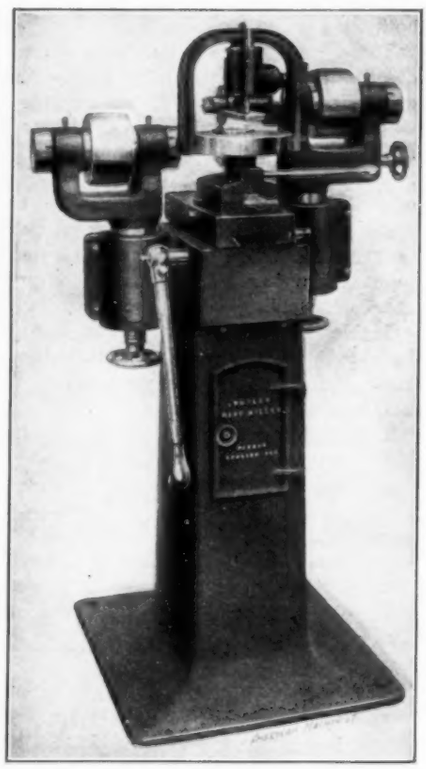
A new molding machine adjustable to different sizes of flasks has been brought out by the Osborn Manufacturing Company, Cleveland, Ohio. The machine is arranged to take 15 different lengths and four regular widths of flasks, either solid or snap. The machine is made in three regular sizes, handling flasks from 9x10 inches up to 20x34 inches.

A Duplex Milling Machine for Piston Rings

The halftone shows a duplex ring milling machine designed for milling the lap in piston rings from two to eight inches in diameter.

Two cutters are used, one above and the other below, cutting both sides of the ring and jointing it at one operation. The machine is fitted with an air-actuated clamping device which clamps and unclamps the rings instantly. It is equipped with a countershaft, two high-speed steel milling cutters and the necessary wrenches.

The spindles are adjustable so that the lap in the ring can be cut any desired width. The heads have micrometer adjustment up and down and any width of



Duplex Milling Machine for Piston Rings

ring up to ¾-inch can be cut with the same mills. The machine will cut and joint four-inch rings 5/16 inch wide at the rate of 400 per hour.

The air chuck operates under a pressure of from 60 to 80 pounds.

This machine is built by the Ackley & Abbey Machine Company, Battle Creek, Mich.

An Arbor Press

The halftone shows one of a line of arbor presses recently put on the market by the Cleveland Machine Specialty Company, Cleveland, Ohio. It can be mounted on a lathe, bench or pedestal.

AN ARBOR PRESS

The capacity of the machine is 1½-inch arbors to the center of a 12-inch circle and 12 inches high. It will exert a pressure of three tons. The net weight is 108 pounds.

Horizontal Drilling and Boring Machine

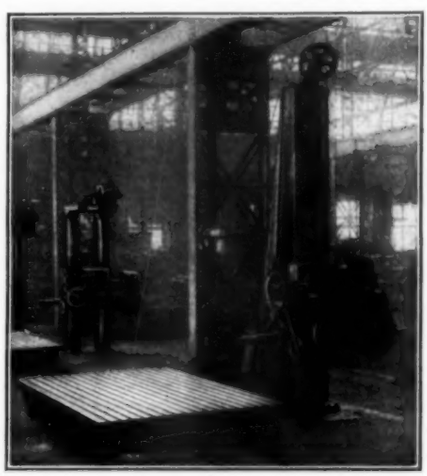
In this machine no overhead support or pit under floor is necessary. The machine may be operated by belt instead of motor, if desired, a pulley being substituted for the motor. The drive is by a constant speed 3-horsepower motor, geared direct to vertical shaft, passing through gear casing. This part of carriage contains all of the speed and feed change gears, spindle and all other operating mechanism. The two columns upon which carriage travels are 7¼ inches in diameter with cored centers and of such length as required. Columns are 8½ feet high, giving approximately 5-foot vertical carriage travel. These columns are held in position by top and bottom plates, latter being bolted to I-beams imbedded in flooring and extended to support the two rails on which work table travels. Counterweight is provided for the carriage at the back, guided by two pipes that are also retained in top and bottom plates, making machine practically self-contained.

Spindle rotation is reversible for tapping and for counterboring from the back by means of a slight movement of lever extending toward the table and just above the spindle.

Eight changes of spindle speed varying from 10 to 200 revolutions per minute through the operation of short levers on front of gear case and the back gear lever can be obtainable. Four speed changes for each spindle are made by direct change gears. Traverse of spindle in either direction and locking and unlocking of the worm-geared feed is by means of the one large handwheel which is part of the automatic device common to all types of horizontal drilling and boring machines made by this company and is a simple, yet positive control for the 24 inches of spindle movement.

The diameter of the spindle of this machine is 2 7/16 inches, the over-all length 8 feet, with the bearings distributed 5 feet apart, thus assuring a true alinement when spindle is at extreme travel. It has a No. 5 Morse taper.

The work table is 8 feet long, 4 feet wide, 3 feet 7 inches gage and stands 15 inches high. It is fitted with improved roller bearings, large diameter axles and chilled wheels. A clamping



HORIZONTAL FLOOR DRILLING MACHINE

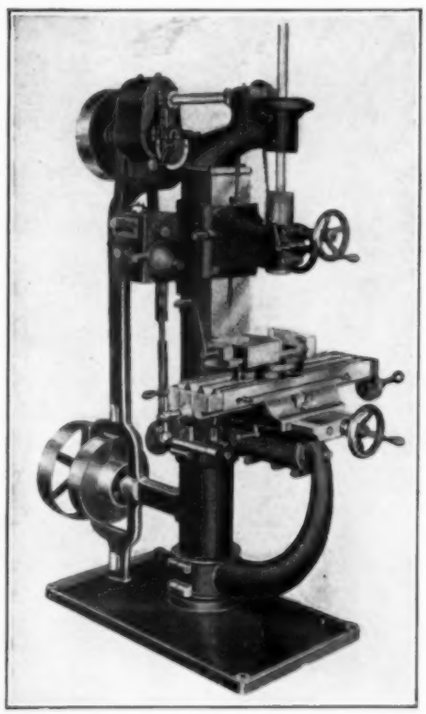
brake on one axle provides for locking the table in position, when desired.

With a carriage travel approximately 5 feet as above mentioned, and the 8-foot table, a surface area of 40 square feet can be covered. For boring with long bars, adjustable outboard bearings clamped to the table and lined to the work and to the spindle are used on this machine.

The machine weighs 5681 pounds, the counterweight 2450 pounds and the table 4710, making a total of 12,841 pounds. The builders are the Pawling & Harnischfeger Company, Milwaukee, Wis.

A Vertical Drilling and Milling Machine

The halftone shows a large size of vertical drilling and milling machine which has recently been brought out by



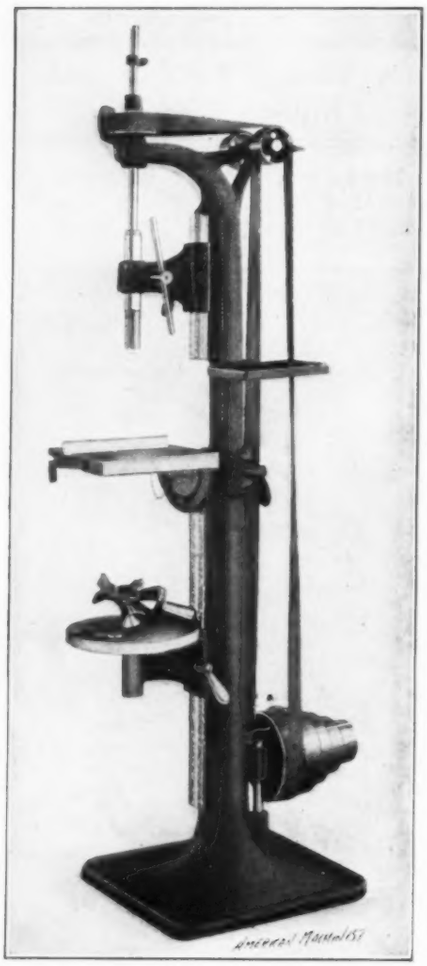
VERTICAL DRILLING AND MILLING MACHINE

the W. B. Knight Machinery Company, St. Louis, Mo.

The knee of the machine is so arranged that the table can be tilted at any angle so that drilling, boring and milling operations at various angles can be performed on a piece of wood at one setting. The vertical movement of the spindle in the spindle head is 4½ inches. The vertical adjustment of the spindle head is 12 inches and when at its extreme hight the end of the spindle is 18 inches from the table. The table is 34x 8½ inches over all, and has an automatic feed of 20 inches in either direction. The cross feed is also automatic 8 inches in either direction. There are 10 feed changes from 0.008 to 0.076 inch per turn of the spindle. The vise swivels and has a graduated base. Floor space necessary, 60x68 inches; weight, about 2000 pounds.

A Sensitve Drill Press

The halftone shows a 14-inch sensitive drill press built by the Rockford Lathe and Drill Company, Rockford, Ill.



SENSITIVE DRILL PRESS

The upper table swings at an angle for angular drilling or can be swung out of the way to permit the lower table to be used.

Wire Forming, Ferruling and Stamping Machine

A new product of the Baird Machine Company, Oakville, Conn., is a combination machine that forms, stamps, and ferrules small wire articles, thus combining their wire-forming and stamping machine and their wire-forming and ferruling machine, both of which were recently illustrated in these columns.

In operation the machine automatically draws wire from the coil, straightening, feeding, cutting-off, forming and stamping it into small articles. Likewise sheet-metal is taken from the reel and in addition is ferruled. Several sizes of the machine are built to cover a wide range of work, the completed articles being turned out at approximately 60 to 80 per minute, according to size and shape.

Maple Syrup as a Lubricant

BY CHAS. A. HAEUSSLER

It wouldn't have happened if his name had been an unusual one; but his name is Brown and he lives in a small town in Michigan. What did happen is told by a motor-boat builder of Detroit.

Brown owns a motor boat that he purchased from Charley Arnold, a friend of his who was an agent for that company. The boat had been running fine for several months during the summer and Brown had written several times to say how delighted he was with his new boat. But one day there came a change, in the form of a letter that detailed all the ills to which a motor boat is heir and winding up with a request for immediate information as to what to do to make the motor perform as of yore. Arnold diagnosed the case as well as he could and sent him a bunch of "absent treatment" by return mail. But it was of no use. A telegram stated all the expedients suggested had been tried, but the motor would not "mote." Arnold wired for more symptoms. In reply he received information that the engine, after much cranking, would start, run a few seconds, smoke, spit and emit a terrible stench. "Seems as if it is running hot" ended the telegram. Arnold suggested examining the pump, commutator, carbureter, coil and everything else he could think of and concluded by advising to "Put plenty of oil in the engine." Brown replied "Nothing doing." Then Arnold got him on the telephone.

"What kind of cylinder oil are you using?" "Same as you sent me last wee' " replied Brown, hotly. "That's good cylinder oil," said Arnold; "but I cannot understand the engine heating." "Put in some more oil." "Got the case half full now," yelled back Brown. "Well, put in some more," replied Arnold, as he slammed the receiver back on the hook.

In half an hour a telegram told Arnold he could send an expert to make the boat run, or take it back. It was in the middle of the selling season and motor boats were going out at the rate of a dozen a day, so that every competent man was required to tune up the new ones. But there was no way out of it; a man must be sent immediately.

"Half a day to go; half an hour to make the engine run and another half day to return," growled Arnold. "Wish that fellow could think of one symptom he didn't tell me, so I could tell him what ails his boat."

Man was absent three days. When he returned he met the infuriated manager, who asked: "What on earth kept you so long; what have you been doing?" "Took his engine all apart; cleaned it and put it back in." "Why; what was wrong with it?"

"This," said the man, setting a can of light brown liquid before his chief.

"That looks like good cylinder oil," said Arnold.

"Looks like it; yes, that's the trouble. It's maple syrup!"

Strange as it may seem, there are two Browns in this Michigan town. A friend had shipped a can of maple syrup to one, on the same day and by the same express company that was carrying the can of cylinder oil from Arnold to the owner of the new motor boat. Cans got mixed *en route*. When the expert took the motor apart, he found the cylinder full of maple syrup, the bearings full of syrup and the muffler choked with the half-burned wax.

Arnold is now wondering how the other Brown relishes cylinder oil on his pancakes.

Samuel M. Bronson

Samuel M. Bronson, general manager and treasurer of the National Machine Company, Hartford, Conn., died February 28.

Mr. Bronson was born in 1832, and since a young man had been actively engaged in business pursuits in his native town. In 1891 Mr. Bronson, with Charles E. Billings and others, organized the National Machine Company, with which he had been actively connected until his death.

What a Carat Is

The word carat or karat means the twenty-fourth part of an ounce troy and is equivalent to 150.5 troy grains. Thus pure gold is called 24-carat gold because twenty-four twenty-fourths of it are gold. An alloy of gold containing 2/24 of silver, copper or other metal would be termed 22-carat gold because 22/24 of the whole are gold. With 6 or 10 twenty-fourths of silver, copper, etc., the alloy is known as 18- and 14-carat gold respectively. The standard for wedding rings is 22-carat. Diamonds are usually set in 18-carat gold and 14-carat gold is used for chains, etc.

The carat as a unit of weight is used to weigh precious stones and is divided into four grains called *diamond grains*, each equal to 3¼ troy grains. 151.5 English carats equal one ounce troy. Diamonds, emeralds, rubies, sapphires, etc., are sold by the carat. The subdivisions are 4ths, 8ths, etc. Pearls are not sold by the carat but by the diamond grain. The inferior gems such as the garnet are sold by the troy ounce.

Ball Turning Device for Libby Turret Lathe

The halftone, Fig. 1, illustrates a ball-turning device made specially by the International Machine Tool Company, Indianapolis, Ind., to go on the Libby turret lathe, in place of the regular cross slide and tool post; no other change being necessary in applying this attachment to the machine. It is driven by power, through the same train of gearing that actuates the cross-feed screw when the cross slide and tool post are used and the drive from these gears is transmitted through a worm to a large worm gear. The worm shaft has a slip gear that can be slid out of mesh with the gear train, so that the tools can be operated by hand, if power feed is not desired.

The device is made for turning balls from 2 to 12 inches in diameter. It consists of a base which fits on the regular carriage and rests upon and is gibbed to the rear way of the bed. Stops are provided so that the center of the swivel head will line up with the center of the spindle.

The tool post is arranged to carry three tools, two roughing and one finishing. As the balls which the device was designed for machining are turned for only about 45 degrees on each side of the center, the roughing tools are set so that each tool covers half the distance to be turned.

The tool post is of the turret type and can be locked in two positions, one for roughing and one for finishing. The finishing tool makes the whole sweep necessary to finish the ball and is set about 1/64 inch ahead of the roughing tools, so that when the tool post is turned around from the roughing to the finishing position, just the right amount of stock to be removed and the right diameter are obtained by means of the one stop.

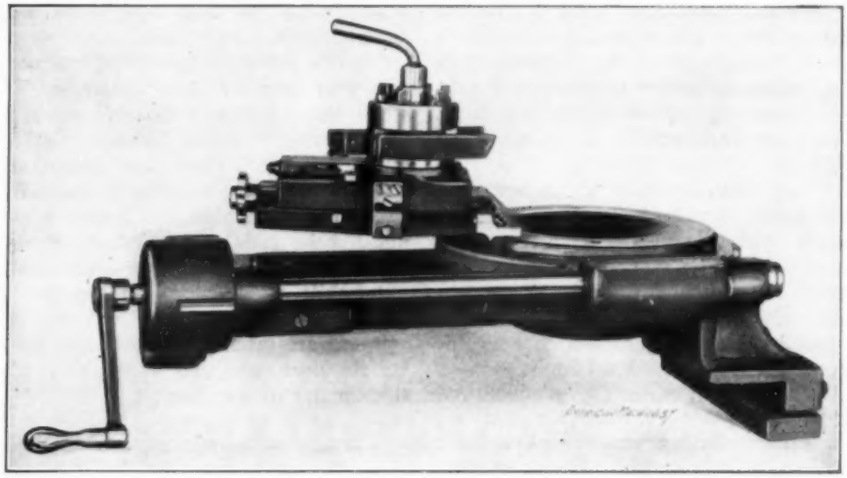


FIG. 1. BALL-TURNING ATTACHMENT FOR LIBBY TURRET LATHE

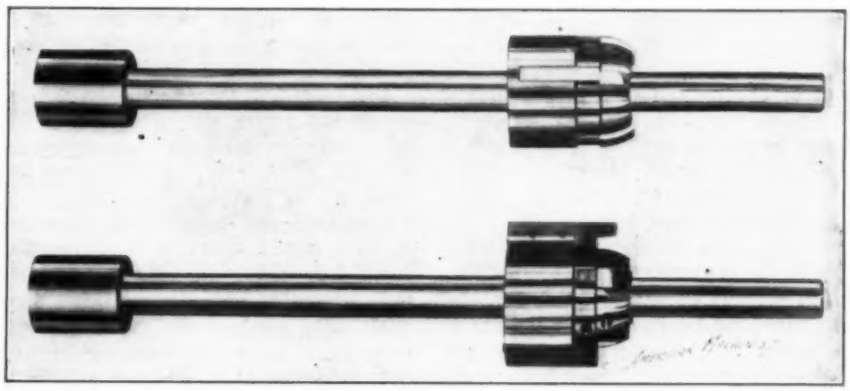


FIG. 2. SPHERICAL SEAT-FORMING TOOLS FOR LIBBY TURRET LATHE

Fig. 2 illustrates a pair of turret tools with inserted cutters used for finishing spherical seats and for facing the end of the work. The cutter heads are fitted with inserted blades and the outer ends of the bars are provided with pilots which are supported in the head spindle to hold the bar rigid under the action of the cut.

Rubbing Off Cast Iron—Suiting the Market

By John R. Godfrey

When it comes to simplicity, everyone admits that the two-cycle, air-cooled engine has everything else beaten to a frazzle, and there has been some progress made along that line. But every gas engine man is full of "buts" when you talk to him along that line—and perhaps not without reason.

The air-cooled, four-cycle engine has not been without its troubles, although many are running very successfully, but—the two-cycle engine has twice as many explosions, burns twice as much gas and must develop an increased proportion of heat. And the getting rid of this increased heat is what the builders seem to be up against.

One experimenter claims that when cast iron is kept at a high heat there is a tendency to disintegrate, that the particles lose their cohesion, and the action of the rings in the cylinder actually rubs off particles of the metal. This discourages the formation of the mirror-like gloss which is so desirable in any engine cylinder and shortens the life of the engine by producing undue wear and allowing leakage past the rings much sooner than would otherwise be the case.

But it is a nervy, or it might be almost safe to say, a foolish man, who predicts that it can't be done. For, the first thing we know, some fellow who isn't half as bright as we are in any way, has a disconcerting way of coming along and doing it right before our eyes. And the chap who does it in this case will win more or less glory—the cash too often goes to someone else. But it's worth while thinking over just the same for the mere doing of a good thing is worth while in itself.

SUITING THE MARKET

I had an interesting chat with an automobile builder the other day and some of his experiences fit equally well in the machine trade. He was one of the pioneers and I can't do better than to quote his words as near as I can remember them.

"I was in the game early and I bucked popular opinion by putting out cars which were different from the others but simpler, and I believe, better in many ways.

I thought a simple car would please the multitude, one that they could take care of and operate as easily as driving a horse.

"I knew the average man had no use for a heavy, high-powered car, that a good 20-horse motor would carry him as fast as he ought to travel and take him over any hill plenty fast enough. But I guessed wrong as to what he wanted.

"Talk about styles in women's clothes and the sane and sensible men who are not swayed by styles or fashions. Forget it. What the average man wants is a car just as fast and as heavy as his neighbor's. Whether it is simple or complicated doesn't cut any ice—he wants to be in style just as the women do.

"I'm through with the pioneer act. When the demand comes for light and simple cars as it will before many years, I'll be ready for it. But as long as they want road locomotives they can have them. If they want them with six wheels they'll get them.

"Here's a 60-horsepower car, built new this year and the best seller of the whole line. It's twice as much power as is safe in the hands of the average driver and I feel like a malefactor to turn out such a juggernaut for general use. But I've got to get back the money I lost bucking the fashions and I'll be only too glad to build a really sensible family automobile when they get ready for it."

There are machine-tool builders along certain lines who can sympathize with this builder of automobiles.

Taft-Peirce Evening Educational Classes

The Taft-Peirce Manufacturing Company, of Woonsocket, R. I., has recently organized a series of evening educational classes for the young men and boys in its employment, and has secured the services of two experienced teachers, one for algebra and arithmetic, the other for mechanical drawing and shop practice. Between thirty and forty boys are enrolled, and the average attendance per month is between ninety and one hundred.

This company is also considering the proposition of establishing a restaurant near its factory, where it is expected that table capacity for at least 120 men will be provided.

Peculiar Oxygen Tank Explosion

Editorial Correspondence

On Tuesday, February 22, in the automobile repair shop of Alton, Laine & Co., New York City, a disastrous explosion of the oxygen tank and generator of an oxyacetylene welding outfit, resulted in the literal blowing to pieces of one man, the severe injury of another, and the wrecking of a portion of a building. Strange to say, however, the acetylene seems to have played no part whatever in the explosion.

The welding apparatus which exploded was furnished by the Beltzer, Delcampe Company, of Bridgeport, Conn., and is of the self-generating type. Acetylene is generated in one tank by the action of water on calcium carbide and flames from this are used to heat two small steel cylindrical retorts, in which oxygen is generated. This oxygen is led from the retorts to a steel storage tank about 14 inches diameter by 6 feet high. The connections are with wrought-iron pipe about ⅜ inch diameter and the large oxygen tank was provided with two safety valves, said to be set at about 300 pounds and a pressure gage reading to the same figure. The side seam is lap riveted.

The oxygen-generating retorts are of seamless steel tube about 4 inches diameter by about 14 inches long, closed at one end by a hemispherical head, integral with the shell and at the other end by a cover flange, bolted to a flange screwed onto the end of the tube.

In the explosion the flanges of one retort were forced from the end of the tubing and, strange to say, with scarcely any destructive effect upon the threads. The head seems to have slid right off. However, at the base of the threads cut on the tube, a tear occurred in the metal about 2½ inches long and opened about ¼ inch. This seems to indicate that the threaded portion started to tear away from the body of the tube before the flanges slipped the threads and flew off. The other retort was practically uninjured.

Far exceeding the effect upon the one generating retort, the explosion of the oxygen-storage tank was completely destructive. The side of the tank tore open, not at the seam, but in the solid metal, from end to end and the sheet, which is almost 3/16 inch thick, was bent completely back, literally turning the tank wrongside out. By a jagged diagonal tear, one-half of the sheet was twisted so as to be reversed end for end, and in one place a jagged hole in the metal seems to show where, in its passage through the roof of the building, it was pierced by something hard and sharp. This hole is entirely separate from any of the other tears, so in no way can it be considered as the start of the rupture. If it had been the start, the rupture would have continued from this hole. It is rather peculiar that, as already stated, the tear in the sheet was not at the riveted seam, nor yet right along the edge of the lap. It was an inch back of the lap. One large piece was torn completely out of the sheet, embracing about half the diameter for a vertical hight of about two feet.

As is usual in the case of a destructive explosion, there was little evidence upon which to base a theory of the cause. Two possible causes, however, are apparently disproved at once. These are: First, lack of strength or presence of a defect in the material; secondly, a gradually increased pressure due to careless operation. As to lack of strength or presence of a defect, if this had been the cause of explosion of the oxygen storage tank, what should make the generator blow its head off at the same instant? They could not have been so exactly alike in strength or weakness that they would both give way together, and it should be remembered that one generator-retort shell was torn in the metal, as well as the giving away of the threads.

As to the second possibility, gradual increase of pressure due to carelessness, this also hardly could have resulted in the rupture of both tank and generator retort at the same instant. In this case, one vessel, the weaker, must certainly have exploded first; for, as they were connected together by the pipe, the pressure would have been equal in both. Furthermore, bursting of the first one would have relieved the pressure in the second, so that it could not have exploded.

With the elimination of these two possible causes, there remains the possibility of very suddenly increased pressure from some combustion inside the apparatus. From the fact that the main tank was so completely destroyed, being literally torn asunder and ripped and twisted out of all semblance to a tank, while the generating retort was so comparatively little damaged, it would at first appear that the explosion took place in the storage tank. The instantaneous increase in pressure which may have occurred in this tank first, could have had full opportunity to destroy this tank, while the comparatively small diameter of the connecting pipe choked back the pressure sufficiently to produce only the comparatively slight damage to the generator, before the pressure was relieved by the explosion.

However, it may be contended that, being larger and of thinner material, relative to its diameter, than the generators, the resulting destruction to the tank was greater. This is perfectly possible and so it is also possible that the explosion came from the chemicals used

to generate the oxygen in one of the retorts.

The fact that one generator was apparently uninjured seems to bear out this theory, because if the explosion starting in the other generator, the pressure reached only the main tank with power enough to burst it and the small-diameter pipe connecting the second generator with the tank, together with the relatively greater strength of the generator retorts saved the second one entirely. The very bursting of the main tank, relieving the pressure instantly, would protect the second generator.

What could have caused the chemicals to explode it would be difficult to say, unless it was some entirely foreign impurity, and if the origin is assumed to have been in the storage tank, there seems to be absolutely nothing to have caused the explosion. The storage tank was simply a steel shell, cylindrical reservoir to hold the oxygen generated. Pure oxygen is nonexplosive. It is the active agent of the atmosphere and naturally will not burn in air. Oil, or other carboniferous substance, however, once ignited will burn violently in oxygen, producing a high temperature, and pressure if in a confined space.

It is possible therefore, that some such foreign substance was inside the oxygen apparatus and this, acted upon by the heat to generate the oxygen, caused ignition and explosion.

There is no connection at all between the acetylene generator and oxygen tanks, so it seems impossible that there could have been any mixture of the two gases inside the apparatus. As a matter of fact the acetylene flame is said to have been extinguished by the explosion, the acetylene generator being unharmed. This fact and also that the building at once took fire, would seem to indicate that the explosion itself produced a flame.

In this particular make of apparatus the usual working pressure of the oxygen was about 150 pounds per square inch, and it is supposed to have been working at this pressure up to the time the explosion occurred.

Increasing Shop Capacities

Where More Tools will be needed

The Mais Motor Truck Company is to build a plant in Peru, Ind.

John A. East is erecting a foundry at Saskatoon, Sask., Canada.

The Minnesota Stove Works, Shakopee, Minn., will build an addition.

The Moose Jaw (Sask.) Machine Works expect to build a plant this summer.

The St. Louis (Mo.) Electric and Heating Company will erect a new factory.

The Lincoln Grain Company will build a large grain elevator at Omaha, Neb.

The Toronto (Ont.) Show Case Company will erect a new factory to cost $32,000.

The H. L. Bennett Box Company, Seattle, Wash., will erect a two-story addition.

The Sligo Iron and Steel Company, Connellsville, Penn., will increase its output.

The Western Stove Works, Peoria, Ill., recently destroyed by fire, is to be rebuilt.

The Hendey Machine Company, Torrington, Conn., will build an addition to its plant.

The H. B. Drake Woodworking Company, Bayonne, N. J., is to erect a new factory.

The Harrison Machine Works, Belleville, Ill., is erecting an addition to its foundry.

The Cyclone Drill Company, Orrville, Ohio, is preparing plans for extensions to its plant.

The Never Break Range Company, Belleville, Ill., is erecting an addition to its plant.

The United Cork Company, Hoboken, N. J., will erect a new factory at Kingsland, N. J.

The Kirkham Motor Manufacturing Company, Bath, N. Y., is enlarging its factory.

The Krey Packing Company, St. Louis, Mo., will erect a new engine room to cost $10,000.

Plans are being prepared for a new plant for the Continental Bolt Company, Chicago, Ill.

The Sikes Chair Company, Buffalo, N. Y., is having plans prepared for a six-story factory.

The Bacon Garage Company, Hackensack, N. J., will erect an addition to its repair shop.

The D. Connelly Boiler Company, Cleveland, Ohio., will erect a new plant in Collinwood.

The Kappler-Fox Foundry Company, Philadelphia, Penn., will erect a four-story addition.

The Deming Company, Salem, Ohio, pump manufacturers, will erect a four-story addition.

Authentic news is solicited for this department. Real opportunities for the sale of machinery of any kind.

The hosiery mill of the Vaughn Knitting Company, Pottstown, Penn., was destroyed by fire.

The Wyoming Coal Company, Rock Springs, Wyo., will install a coal-washing plant for nut coal.

The Hudson County Consumers' Brewing Company, West Hoboken, N. J., will build an addition.

The Louisville, Henderson & St. Louis Railroad will build a new roundhouse at Cloverport, Ky.

The Clarence G. Garrigus Machine Company, Bristol, Conn., will erect an addition to its plant.

It is said the Valk Pump Manufacturing Company, of Topeka, Kan., will soon enlarge its plant.

The Indian Refining Company, 115 Broadway, New York, will erect a plant in Newark, N. J.

The American Asbestos Company, Norristown, Penn., will erect a new engine and boiler room.

The Manchester Biscuit Company, of Sioux Falls, S. D., will erect a branch plant in Fargo, N. D.

Crouch & Beahan, Rochester, N. Y., will build a $10,000 addition to their sash and door factory.

Machine shop for the Public Belt, New Orleans, La., is to be erected at St. Louis and Clay streets.

The Denver (Colo.) Rock Drill and Machine Company will erect a new plant to cost $200,000.

The Sims-Jeffries Company, Columbus, Ohio, is preparing to rebuild its candy factory recently burned.

The plant of the Burlington (Iowa) Gas Light Company was wrecked by an explosion. Will be rebuilt.

The Virginian Railway has purchased ground in Roanoke, Va., on which repair shops will be erected.

The Vulcan Steam Shovel Company, Toledo, Ohio, is negotiating for a location in Evansville, Ind.

The Great Northern Railway will spend $500,000 on the enlargement of its shops at Hillyard, Wash.

The Lamon Carriage Manufacturing Company, Greenville, Tenn., will establish a plant in Bristol, Tenn.

The U. S. Steel Corporation is planning the erection of a cement plant at Buffington, Ind., to cost $2,500,000.

New machinery is to be installed in the Natchez (Miss.) Cotton Mill to replace the present machinery.

The Saunders & Westrand Grain Company, Omaha, Neb., is planning the erection of a new grain elevator.

The flour mill of the Arkadelphia (Ark.) Milling Company, destroyed by fire sometime ago, is to be rebuilt.

The plant of the New Milford (Conn.) Foundry and Machine Company was burned. Loss, about $20,000.

The Taylor Pneumatic Jack Company, of Louisville, Ky., will probably establish its factory in Atlanta, Ga.

Adams & Kelly, Omaha, Neb., sash and door manufacturers, is erecting an addition to cost about $75,000.

C. G. Kennedy, Osceola Mills, Penn., operating sawmill, is in the market for a 30-horsepower portable boiler.

The factory of the Harder Automobile Company, Chicago, Ill., was damaged by fire to the extent of $50,000.

The Beatrice (Neb.) Cold Storage Company will remodel its plant. Engines, boilers and dynamos will be needed.

The Belleville (Ill.) Stove Works has awarded contract for the erection of an addition to its range department.

Fire partly destroyed the embroidery plant of Max Hagger, Union Hill, N. J., doing considerable damage to machinery.

F. A. Ringler Company, 21 Barclay street, New York, electrotypers, will erect a new factory in West Hoboken, N. J.

The plant of the New Milford (Conn.) Foundry and Machine Company was burned, causing a loss of about $20,000.

The Continental Can Company, of Syracuse, N. Y., has let contract for the erection of a plant at Canonsburg, Penn.

The Metz Manufacturing Company, Dubuque, Iowa, making sash, doors, frames, etc., will build an addition to its plant.

Fire destroyed the machine shop of Tobias Hedges, Pottstown, Penn., including some modern machinery recently installed.

Fire destroyed the main building of McGregor's boiler works and machine shop at Cheboygan, Mich., causing $10,000 loss.

The Manchurian Mint and the Electric Light Works, Mukden, China, would like catalogs on all kinds of machine tools.

The Power and Mining Machinery Company, Cudahy, Wis., has issued a list of tools needed for the gas-engine department.

The Davidson Manufacturing Company has leased a plant at Attica, N. Y., and will equip for the manufacture of vacuum cleaners.

The veneer plant of the Portland Manufacturing Company, St. Johns, Ore., was destroyed by fire. Loss, about $100,000.

The Eureka & Palisade Railway Company, Palisade, Nev., is in the market for a 14-, 16- or 18-inch lathe. H. H. Keysaw, M. M.

The C. W. Raymond Company, Dayton, O., building brick and clay machinery, is having plans prepared for a new $150,000 plant.

The World's Star Knitting Company, Bay City, Mich., is making preparations to erect a new mill, which will double its capacity.

Guthrie & Co., Superior, Neb., owning electric plant, are planning the enlargement of the present building or the erection of a new one.

The city of Fort Wayne, Ind., is building a machine shop for city repairing for which some tools and machinery are to be purchased.

The Ferro Machine and Foundry Company, Cleveland, Ohio, has let contract for the erection of an addition to its new machine shop.

Plans for a new plant for the Albany (N. Y.) Chemical Company are nearing completion and contracts will soon be awarded.

The Saskatchewan Motor Company, Regina, Sask., Canada, will probably enlarge its plant this summer. Is buying machine tools.

The C. Mattison Machine Works, Beloit, Wis., will erect a two-story addition. The company manufactures woodworking lathes, etc.

The Doty Engine Works, Goderich, Ont., will establish machine and boiler shop at Winnipeg, in connection with its shipbuilding yard.

The Magnus Wilson Company, 411 Van Brunt street, Brooklyn, N. Y., has enlarged its machine shop and is about to add more lathes.

The Farley & Loetscher Manufacturing Company, Dubuque, Iowa, manufacturing sash, doors, blinds, etc., will erect a five-story addition.

The plant and power house of the New York Veneer Seating Company, Jersey City, N. J., was destroyed by fire. Loss, about $200,000.

The T. B. Woods' Sons Company, Chambersburg, Penn., will build additions to its plant, including foundry and machine shop, pattern shop, etc.

C. N. A. Dissinger & Bro. Company, Wrightsville, Penn., manufacturing gas and gasolene engines, is negotiating for a location in Lancaster, Penn.

The Dart Manufacturing Company, Anderson, Ind., manufacturing automobile supplies, will probably move to Waterloo, Iowa, or Dayton, Ohio.

The Western Dominion Collieries Company, Taylorton, Sask., Can., will purchase some electrical machinery and probably install electric hoists.

The Gowland Manufacturing Company, Incorporated, Phillipsburg, Penn., expect to purchase about 18 motors, ½ to 10 horsepower, before April 1.

The plant of the Forsythe Steel Tie Company, Verona, Penn., will be moved to Youngstown, Ohio, where a new and larger plant will be erected.

The Novelty Candy and Chocolate Company, Jersey City, N. J., will build an addition to its plant, also increase the capacity of its power plant.

The John A. Roebling Sons' Company, Trenton, N. J., manufacturing wire rope, etc., has taken out permit for the erection of a $40,000 addition.

The Union Woodworking Company is having plans drawn for a six-story factory on Faile street, near Seneca avenue, Hunts Point, Bronx, New York.

The Aluminum Casting Company has filed plans for the first of a number of buildings to be erected on property purchased on Elmwood avenue, Buffalo, N. Y.

The Southwestern Iron Works, of Gainsville, Tex., will locate on Delmar Heights, Oklahoma City, where a new plant to cost $100,000 will be erected.

The McIntosh & Vick Auto. Company will build a garage at Saskatoon, Sask., Can. Machine tools, including lathe, drill press, forge, brazing outfit will be installed.

It is reported that the Kissel Car Company, of Hartford, Wis., will remove to Waterloo soon. The company manufactures automobiles, auto trucks and farm implements.

The National Roll and Foundry Company, of Pittsburg, Penn., will install a 50-ton open-hearth furnace at its plant in Avonmore, so that it can produce its own steel castings.

The machine shop of the Bakersfield Iron Works at Oil City, Cal., was destroyed by fire. New corrugated iron building will be erected and equipped with modern machinery.

Announcement has been made that the Lake Shore & Michigan Southern Railroad will start at once the erection of locomotive and car shops at Elkhart, Ind., to cost $3,000,000.

The Southern Pacific Railroad Company has commenced the erection of a building at Alameda Point, Cal., where the repair work for a suburban electric system is to be done.

Fallansbee Bros. Tin Company, Steubenville, Ohio, plan to erect two additional sheet mills, together with heating and annealing furnaces. New power plant will also be erected.

The Clover Leaf Railroad has appropriated $250,000 for additions and improvements to its shops at Frankfort, Ind. New roundhouse, new machine shop and coach shop will be erected.

The Vulcan Iron Works, New Britain, Conn., will make another addition to its plant. The company is making preparations for occupancy of a new foundry now nearly completed.

Gade Bros. Manufacturing Company, Iowa Falls, Iowa, will rebuild at once, machine shop, recently destroyed by fire. Machine tools for the manufacture of gasolene engines will be needed.

Fire destroyed part of the plant of the Voelkner & Harry Manufacturing Company, Detroit, Mich. Loss, about $80,000. The company manufactures cabinet hardware, mattresses and plumber supplies.

The Isthmian Canal Commission, Washington, D. C., will receive bids up to 10:30 a.m., April 4, for furnishing electrical material for the period ending June 30, 1911, including transformers, fixtures, fittings, carbons, cable wire, insulating material, etc., as per Circular No. 565.

The Leece-Neville Company, Cleveland, Ohio, recently incorporated with $10,000 capital, expects to equip a plant shortly for the manufacture of electrical accessories for automobiles. B. M. Leece and A. E. Leece, of the Electrical Manufacturing Company, 1363 West Second street, are among the incorporators.

The Rockwood Sprinkler Company, Chicago, Ill., has put its new works into operation. This is equipped with the latest machinery used in the manufacture of its fire protection apparatus. The company contemplates making additions as soon as weather permits, consisting of machine shop, foundry and storage building.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open the following bids: March 15—Crucibles (schedule 2301), rolled bronze, sheet copper (schedule 2300), bar steel, galvanized sheet steel, carbon-tool steel B and C (schedule 2298), machinery steel (schedule 2301), iron-pipe fittings (schedule 2295), seamless copper tubing (schedule 2300), valves (schedule 2301).

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open bids, March 15, for grinder (schedule 2296), polishing and buffing lathes (schedule 2287), crushing roll, screen (schedule 2296); March 29—Steel bolts and nuts (schedule 2292), files, steel rivets, screw wrenches (schedule 2291), seamless drawn brass and copper pipe (schedule 2293), lead pipe (schedule 2291), steam steel pipe (schedule 2292).

NEW INCORPORATIONS

Lake Gas System Company, St. Joseph, Mo. Manufacture appliances for producing acetylene and other gas. Capital, $20,000.

Smith & Wallace, Woburn, Mass. Manufacture and sale of engines of all kinds. Capital, $250,000. J. E. Wallace, president.

G. W. Dyer Company, Providence, R. I. Manufacture jewelry. Capital, $20,000. Incorporators, G. W. Dyer, N. L. Dyer, C. H. C. Carter.

Burkhart Automatic Shoe Polishing Machine Company, Buffalo, N. Y. Capital, $2,500,000. Directors, C. E. Burkhart, A. J. Wright, A. B. Wright.

Hall Development Company, New York. Manufacture engines, motor vehicles, etc. Capital, $100,000. Incorporators, H. A. Van Llew, H. P. Hall, B. H. Howell.

Holdfirm Hair Pin Company, New York. Manufacture machinery, tools, hair pins, etc. Capital, $100,000. Incorporators, W. Koehler, W. J. C. Gussenrode, A. Kaplan.

Matador Tire and Vulcanizing Company, Chicago, Ill. Automobile and garage business. Capital, $60,000. Incorporators, L. G. Smith, J. R. Findlater, C. C. Griswold.

Golden Vibrator Company, Newark, N. J. Manufacture models, tools, specialties. Capital, $250,000. Incorporators, W. S. Scammell, H. H. Poole, Jas. McEwan.

Perry Steel Company, Buffalo, N. Y. Manufacture iron and steel and products from same. Capital, $100,000. Incorporators, G. W. Perry, W. J. Work, H. Forrester.

Newark Motor Car Company, Newark, N. J. Manufacture and deal in automobiles, motor cycles, etc. Capital, $50,000. Incorporators, J. M. Schwerin, Fred Dudley, A. A. Russell.

The Beverly-Rancocas Brick and Tile Company, Trenton, N. J. Manufacture brick, clay, tile, etc. Capital, $125,000. Incorporators, George E. La Barre, P. E. Wurfflein, J. R. D. Bower.

Black Motor Car Company, New York. Manufacture and sell engines, auto vehicles, etc. Capital, $25,000. Incorporators, C. C.

Darnall, Chicago, Ill.; O. F. Rost, E. R. Rost, Mt. Vernon, N. Y.

Myers-Wolf Manufacturing Company, Newark, N. J. Manufacture pencil sharpeners, mechanical fans, etc. Capital, $30,000. Incorporators, C. L. Williams, E. L. Quackenbush, Geo. W. Perry.

Multiple Engineering Company, New York. Manufacture and repair electric motors, dynamos, etc. Capital, $100,000. Incorporators, C. Marcell, A. D. Thorburn, New York; E. E. Askew, West Hoboken, N. J.

BUSINESS ITEMS

Prentiss Vise Company will move about April 15 from its present address, 44 Barclay street, to 106-110 Lafayette street, corner Walker street, New York City.

The Buffalo Foundry and Machine Company, Buffalo, N. Y., is considerably enlarging its plant. A new steel and concrete machine shop is to be constructed, approximating $200,000 in cost, and the company is about to take up several other lines of manufacture in addition to those it is already in.

TRADE CATALOGS

Gisholt Machine Company, Madison, Wis. Catalog of turret lathes. Illustrated, 64 pages, 8x10 inches, paper.

The Blaisdell Machinery Company, Bradford, Penn. Catalog describing automatic sewage ejector. Illustrated, 6x9 inches, paper.

W. S. Rockwell Company, 50 Church street, New York. Catalog No. 3, describing fuel oil and gas-burning appliances. Illustrated, 34 pages, 6x9 inches, paper.

Watson-Stillman Company, 50 Church street, New York. Catalog No. 78, describing hydraulic valves and fittings. Illustrated, 120 pages, 6x9 inches, paper.

National Brake and Electric Company, Milwaukee, Wis. Bulletin No. 387, describing type "3VS" motor-driven air compressors. Illustrated, 36 pages, 6x9 inches, paper.

FORTHCOMING MEETINGS

Southern Supply and Machinery Dealers' Association and American Supply and Machinery Manufacturers' Association, joint convention, Jacksonville, Fla., April 5, 6 and 7, 1910, Hotel Seminole. F. D. Mitchell, secretary, 309 Broadway, New York City.

National Metal Trades Association, annual convention, Hotel Astor, New York City, April 13-14, 1910. Robert Wuest, Commissioner, New England building, Cleveland, Ohio.

International Railway General Foremen's Association, annual convention, May 3-7, Grand hotel, Cincinnati, Ohio. L. H. Bryan, secretary, Two Harbors, Minn.

American Society of Mechanical Engineers, spring meetings, Atlantic City, N. J., May 31-June 3. Calvin W. Rice, secretary, 29 West Thirty-ninth street, New York City.

American Foundrymen's Association and American Brass Founders Association; joint convention, June 7-8-9, Detroit, Mich.; headquarters, Hotel Pontchartrain. Richard Moldenke, secretary, Watchung, N. J.

National Gas and Gasolene Engine Trades Association. Semi-annual convention, Cincinnati, Ohio, June 13-16, 1910; headquarters, Hotel Sinton. Albert Stritmatter, secretary, Cincinnati, Ohio.

Master Car Builders Association; annual meeting June 15-17, Atlantic City, N. J. J. W. Taylor, secretary, Old Colony building, Chicago, Ill.

American Railway Master Mechanics Association, June 20-22, Atlantic City, N. J. J. W. Taylor, secretary, Old Colony building, Chicago, Ill.

Joint meeting of American Society of Mechanical Engineers and Institution of Mechanical Engineers, Birmingham, England, July 26-29, 1910.

American Society of Mechanical Engineers; monthly meeting second Tuesday. Calvin W. Rice, secretary, 29 West Thirty-ninth street, New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's hotel. D. F. P. Clark, secretary, 309 Milk street, Boston, Mass.

Providence Association of Mechanical Engineers. Monthly meeting fourth Tuesday each month. E. C. Bliss, president, 91 Sabine street, Providence, R. I.

New England Foundrymen's Association; regular meeting second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania; monthly meeting third Tuesday. Elmer K. Hiles, secretary, Fulton building, Pittsburg, Penn.

Superintendents' and Foremen's Club of Cleveland; monthly meeting third Saturday. Phil. Frankel, secretary, 310 New England building, Cleveland, O.

Western Society of Engineers, Chicago, Ill. Regular meeting first Wednesday evening of each month, excepting July and August. Secretary, J. H. Warder, 1735 Monadnock block, Chicago, Ill.

WANT ADVERTISEMENTS

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendations or other papers of value should not be inclosed to unknown correspondents. Only bona-fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Wanted—Diemakers. Apply to Robert N. Bassett Co., Derby, Conn.

Experienced jig and gage designers wanted; steady employment promised. Box 245, AM. M.

Wanted—An A-1 barrel borer experienced and competent to handle a department turning out high grade rifles; must know how to get immense output at minimum costs. Box 277, AMERICAN MACHINIST.

Wanted—One or two first-class eyelet toolmakers, also one with good executive ability, with view of advancing to foremanship. Answer, stating age, nationality and experience. Correspondence will be treated strictly confidential. Box 289, AMERICAN MACHINIST.

ILLINOIS

Wanted—General foreman for hardware specialty factory; must be experienced in general machine work, grinding, assembling, etc.; must be able to systematize and produce results; state age, salary wanted, etc. "Specialty," AMERICAN MACHINIST.

Wanted—Foreman for blacksmith shop, manufacturing implements; must be sober and capable man and a hustler who can produce results with our present equipment; give references and state salary expected in first letter. Box 211, AMERICAN MACHINIST.

A growing concern in the Middle West, building automobile and motorcycle engines, want a time study man who is also an analyst and rate setter; preference will be given to man having knowledge of planning department, speed and gang boss, moving of work, tool delivery, etc. Box 268, AM. MACH.

Wanted—Assistant chief engineer of power stations totaling forty thousand horsepower, and comprising gas engines, turbines and reciprocating engines; those having experience in a similar capacity and who understand handling of men and equipment apply, stating experience, present occupation and pay. Address C-47, Trude Bldg., Chicago, Ill.

INDIANA

Wanted—Machinists, we are continually increasing our force; we invite applications from lathe and floor hands, those who desire a steady position. Apply at Wood Turret Machine Co., Brazil, Ind.

MASSACHUSETTS

Wanted—A draftsman competent to work up layouts from rough sketches; must be accurate in detail. Reply giving experience in full and wages expected. Box 275, AM. MA.

Wanted—A-1 grinder hands on internal and external Landis and Brown & Sharpe machines; two first-class operators on Gleason generators. Box 304, AMERICAN MACHINIST.

Wanted—Operator for Brown & Sharpe and Pratt & Whitney automatic screw machines; good pay and steady employment to the right man; preference given to man able to do camming. Box 226, AMERICAN MACHINIST.

Wanted—Small, well established manufactory wants a competent mechanical man to take charge as superintendent; to one familiar with automatic screw machines, foot and power presses, also second operation work and with some experience in tool making, this is an exceptional opportunity; state age, experience and salary. Box 225, AM. MA.

Wanted—An energetic young man, technical education preferred, to introduce a special brand of steel for machine tool parts in New England territory; permanent position at good salary; applicant should have good general knowledge of qualities required in various machine tool parts; no application considered except from parties of highest standard of character and ability; all applications treated in strictest confidence. Address with full particulars, P. O. Box 1188, Boston, Mass.

We are increasing our force and invite applications from experienced iron and brass moulders, core makers, chippers, pattern makers, draftsmen, production men, machine tool operators (all kinds), brass finishers, polishers, layout men, bench hands, erectors, etc. Heavy and light engine and pump manufacture; works handy to Boston and best evening schools; no labor trouble, and applicants are notified as soon as positions are open; applicants should state age, height, weight and experience in detail. Address Employment Division, Blake & Knowles Steam Pump Works, East Cambridge, Mass.

MICHIGAN

Wanted—Toolmakers, die sinkers, lathe hands, machinists and automatic screw machine operators; A-1 men only. Buick Motor Co., Flint, Mich.

Gasolene engine factory in southern Michigan requires more toolmakers, patternmakers and draftsmen on engine and tool and fixture work; applications from first-class men should state age, experience and wages required. Holms Machine Mfg. Co., Sparta, Mich.

Wanted—Assistant superintendent for automobile factory; must be a hustler and able to show from past record that he can produce results, capable of handling men and have executive ability; age 28 to 35; in answering give references, experience and salary expected. Box 287, AMERICAN MACHINIST.

MISSOURI

Foreman Wanted—An experienced man capable of taking charge of 100 men who thoroughly understands the manufacture of woodworking machinery. Address giving experience, nationality, age, reference and salary. Box 208, AMERICAN MACHINIST.

NEBRASKA

Wanted—In city of Middle West, first-class machinist to operate upright style of mill roll corrugating machine; must have had experience in this class of work and be familiar with the milling industry. Box 254, AM. MA.

NEW JERSEY

Man to take charge of tool room; state experience and wages expected. Ferracute Machine Company, Bridgeton, New Jersey.

Wanted—Draftsmen familiar with machine tool work; give references and salary expected. Box 215, AMERICAN MACHINIST.

Wanted—Draftsmen familiar with heavy turret lathe work; give references and salary expected. Box 216, AMERICAN MACHINIST.

Men wanted to become mechanical draftsmen; pay $35 to $75 weekly; complete course at your home 4 months. Box 433, Newark, N. J.

Draftsman Wanted—A good designer on web printing presses; permanent position; state experience, references, salary; applications strictly confidential. Box 307, AM. MA.

Draftsman Wanted—Several competent designers familiar with printing or similar large automatic machinery; state experience, age and salary desired. Box 293, AMER. MACH.

Wanted—A-1 general foreman, competent to get maximum production in all departments of general machine shop; capable of taking charge of entire plant; give reference, age and salary expected. Box 286, AM. MA.

NEW YORK

Wanted—First-class diemakers, for small work; permanent position. Address Weber-Knapp Co., Jamestown, N. Y.

Wanted—First-class jig and fixture draftsman. Apply Mergenthaler Linotype Company, 24 Ryerson St., Brooklyn, N. Y.

Wanted—Mill draftsman, preferably with some structural experience. I. E. Blumgardt, Maxwell-Briscoe Motor Co., Tarrytown, N. Y.

Wanted—Expert toolmakers on punches and dies; good wages and superior shop. Apply Bates Machine Co., 704 Jamaica Ave., Brooklyn, N. Y.

Wanted—First-class toolmakers, experienced on jig, fixture, watch tool and precision work. Apply Mergenthaler Linotype Co., 24 Ryerson St., Brooklyn, N. Y.

Wanted—Experimental machine shop foreman; man familiar with modern tools and job shop methods; state age, experience and salary expected, and furnish references. Address Box 301, AMERICAN MACHINIST.

Wanted—Foundry foreman, experienced in gray iron bench work and machine molding on agricultural work; state age, previous experience and salary expected; give references. Address "L. D.," AMERICAN MACHINIST.

Wanted—Master mechanic, capable of taking charge of jig and die designing, millwrighting, and general plant repair work; state age, previous experience and salary desired; give references. Address "F. R.," AM. M.

Draftsman, thoroughly familiar with hydraulic presses and accumulator systems, wanted in New York City to detail hydraulic machinery; compensation according to ability. Address giving references, "Hydraulic," Box 303, AMERICAN MACHINIST.

Machinists Wanted—We are enlarging our factory and invite applications from machinists; lathe, drill press and milling machine men, Jones & Lamson operators and toolmakers; in making application, state fully qualifications and wages wanted. The Kirkham Motor Mfg. Co., Bath, N. Y.

Wanted—We are constantly increasing our force and invite applications from the following: Machinists, lathe hands, screw machine hands, grinder hands, milling machine hands, motor assemblers, toolmakers, sheet metal die men; we run a nine-hour shop, have desirable surroundings, and offer steady position to desirable characters. Address Superintendent, Maxwell-Briscoe Motor Co., Tarrytown, N. Y.

OHIO

One machine shop foreman who is acquainted with piece work, take charge of fifty men. Box 284, AMERICAN MACHINIST.

Wanted—Foreman to take charge of machine shop employing about thirty-five men, on new and second-hand machinery for the manufacture of paper; this position requires a man who has been accustomed to building new, as well as rebuilding old machinery; a married man preferred; sobriety and honesty absolutely necessary; $1350 a year. Address Shartle Bros., Middletown, O.

Screw machine operator as working foreman to produce maximum and satisfactory output from eight to ten automatic and hand screw machines, standard make; must come well recommended and competent to handle workmen to advantage; state age, experience and wages desired. Box 306, AMER. MACH.

Wanted—First-class machinists, toolmakers die sinkers, lathe, planer, drill press, screw machine, boring and milling machine operators, wood patternmakers, brass molders, polishers, buffers, finishers, spinners, millwrights, hammermen and blacksmiths who are seeking positions or desirous of improving on those which they have, to register their names and addresses with the free Employment Department of the National Metal Trades Association. Address Commissioner's Office, 605 New England Bldg., Cleveland, O.

PENNSYLVANIA

Wanted—Diemaker for small pressed-steel stampings; steady work, good pay to right party. McDowell Manufacturing Co., 541 Wood St., Pittsburg, Penn.

Two first-class machinists and toolmakers wanted in a small shop building light, accurate, automatic machinery; must have ability and be close mechanics, sober and industrious; state age and if married; shop, machinery and location the best. Box 294, AMER. MACH.

Press-shop superintendent; an old established concern with a large press shop wishes to secure a capable man to handle this department; power presses of all sizes are used and a very wide range of work is done; first-class man wanted and position will be a desirable one; applicants should state experience, references, age and salary wanted. Box 255, AMERICAN MACHINIST.

TENNESSEE

Wanted—One (1) experienced planer hand and one (1) experienced assembler, for slide valve engine work. Box 253, AMER. MACH.

WISCONSIN

Draftsman—Wanted a draftsman familiar with tool and jig work. Address Fairbanks-Morse Mfg. Co., Beloit, Wis.

We are enlarging our works, and are in need of mechanics, especially toolmakers, lathe hands, boring mill and boring-bar hands, and Jones & Lamson screw machine hands. Fairbanks-Morse Mfg. Co., Beloit, Wis.

FOREIGN

Norwegian Wanted—A constructor of machine tools and jigs; must have had experience in small sized, uptodate works and enter our employ at once. Brödrene Sundt Machine Tool Mfg. Co., Christiania, Norway.

FOR SALE

A new and most valuable patented tool for machinists or mechanics; will sell patent cheap; something absolutely new and extremely useful. Box 198, AMER. MACHINIST.

Miscellaneous Wants

Caliper catalog free. E.G. Smith, Columbia, Pa.

Wanted, manufactured and sold a machine tool attachment. Box 266, AMER. MACH.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Special machinery accurately built. Screw machine or turret lathe work solicited. Robert J. Emory & Co., Newark, N. J.

For duplicating always use labor saving multiple stops on your lathes. Write for particulars, Box 267, AMERICAN MACHINIST.

Light and medium weight machinery and duplicate parts built to order; tools, jigs, etc. MacCordy Mfg. Co., Amsterdam, N. Y.

Etching plates of all kinds made at reasonable prices; steel a specialty. John F. Ward, 626 E. 6th St., South Boston, Mass.

German-American graduate engineer, desires to represent firm at the coming Berlin exhibition for machinery; American and German references. Box 292, AMER. MACH.

Wanted—Purchaser for No. 2 Farwell milling machine, Grant hobbing machine and Gisholt tool grinder; all practically new and in A-1 condition. Box 755, AMER. MACHINIST.

I wish to change my location to small town; will furnish excellent exclusive line of machines to manufacturer desiring to extend his field. "Superintendent," Box 271, AM. M.

Wanted—Cash buyer for three boilers, two engines, air compressor, dynamo, switchboard and miscellaneous lot of good machine tools. Write your wants. J. Franklin Cary, 26 East Van Buren St., Chicago.

Wanted—Machine work for lathes, shapers, milling machines, screw machines, etc., and would be pleased to figure on your dies, jigs, models, sheet metal stampings and auto parts. The F. G. Marbach Co., Medina, Ohio.

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMERICAN MACHINIST.

We manufacture metal articles, duplicate parts and patented devices of all kinds; we design or build special machinery, dies, tools and jigs; model and experimental work. M. P. Schell Mfg. Co., 1759 Union St., San Francisco, Cal.

Tinned goods; a large foundry in Sweden desires a method of making tinned cast-iron hardware; a reasonable price is offered for the best method, or a good position to a man who thoroughly knows how to apply it. Answer immediately to Aktiebolaget Sodertelge Verkstader, Sodertelge, Sweden.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Wanted—Position as superintendent by a practical man, with 20 years' experience on light manufacturing; understands drafting, toolmaking, designing of dies, jigs, fixtures for interchangeable work; modern methods. Box 308, AMERICAN MACHINIST.

Experienced superintendent, now employed, open for engagement; large experience in manufacturing small or medium interchangeable work; good reliable mechanic with executive ability; thorough experience in modern shop methods. Box 305, AMER. MACH.

ILLINOIS

A successful superintendent of the Otis Elevator Company is seeking change of position. Address Box 230, AMER. MACHINIST.

Position as superintendent; have a thorough knowledge of best machine shop and foundry practice; can get maximum production from men and equipment; accustomed to large works; good reasons for changing. Box 295, AMERICAN MACHINIST.

MASSACHUSETTS

Mechanical engineer, draftsman and designer with shop experience, expert on steam turbines for marine and land service, is open for an engagement; any location. Box 302, AMERICAN MACHINIST.

A young man, 35, who has had extended experience in designing and manufacturing a line of high-grade automatic machinery, for the manufacturer of fine duplicate parts, wishes a position with reliable parties or company, where his efforts would be fully appreciated. Address "E. C. K.," Box 75, 110 Tremont St., Boston, Mass.

NEW JERSEY

Printing-press designer with five years' experience on presses and seven years on general automatic machines, wishes to change April 1; first-class references. Box 300, AM. M.

NEW YORK

Mechanical draftsman wishes position. Box 269, AMERICAN MACHINIST.

Experienced mechanic, designer and toolmaker, specialist in textile machinery, seeks position as draftsman or in shop. Address H. Kazey, Rome, N. Y.

Experienced foreman, middle aged, modern ideas, now employed, desires change; engineering work, dynamos and steam pumps; A-1 hustler; can handle large force with ability. Box 291, AMERICAN MACHINIST.

Position as superintendent, general foreman or assistant to inventor by a man of long experience in light manufacturing, designing of tools and special machinery; the best of references. Box 260, AMERICAN MACHINIST.

Expert mechanic, technically educated, 8 years' practical experience in tool and experimental work, desires position where given an opportunity to show ability; age 29; will go anywhere. Box 288, AMERICAN MACHINIST.

Wanted—Position by expert automatic machine designer; don't answer this advertisement unless you wish to pay well for ability, and desire a small scrap heap in the development of your automatic machinery. Box 297, AMERICAN MACHINIST.

Wanted—By skilled mechanic, well up in modern tool room and machine shop practice, a position as general foreman, or assistant superintendent; have had about 22 years' experience; can furnish best of references; location East. Box 290, AMERICAN MACHINIST.

Die, punch and tool designer, expert; knows die making and sheet-metal formation from A to Z; practical and educated; possesses executive ability to marked degree and is an authority in his lines; age 35 years, wishes position wherein he can earn at least $50 per week. "Native," Box 252, AM. MA.

Mechanical engineer, competent as a designer of automatic and special machinery and exceptionally capable in designing, building and use of complete equipment for producing interchangeable parts for such work as automobiles, bicycles, firearms, typewriters, small machine tools, etc., wishes a position as chief engineer, superintendent or similar one of responsibility. Box 285, AMER. MACHINIST.

OHIO

Designer and draftsman desires change; go anywhere. Box 298, AMERICAN MACHINIST.

Machine and tool designer, technical graduate, 7 years' experience in machine tools, special machinery tools, jigs and fixtures for light high-grade machinery, wishes to make a change. Box 296, AMERICAN MACHINIST.

If you have schemes to be developed send us your specifications; if drawings to be made send us your layouts, and if tracings send us your drawings; electrical machinery and automobiles a specialty. "Designer," Box 369, Station H, Cleveland, Ohio.

PENNSYLVANIA

Gas engine draftsman wants responsible position; many years' experience in all sizes of engines. Box 299, AMERICAN MACHINIST.

Gisholt turret lathe expert is open for engagement; 7 years' broad experience designing equipment and instructing operators; references A-1. Box 283, AMERICAN MACHINIST.

Designing engineer, graduate, age 32, exceptional experience designing and developing new automatic, special machinery, fine apparatus, adding machines, typewriters; inventive and practical; only responsible position considered. Box 280, AMERICAN MACHINIST.

Mechanical engineer, 31 years of age, technical education, 12 years' experience as draftsman, designer, chief draftsman and superintendent, expert on special machinery, experienced and qualified to direct work and handle men, is open for position at comparatively small salary where opportunity of advancement is offered. Box 261, AMER. MACHINIST.

Radial Drilling Machines Break Drills and Records*

Drilling Tests Made by the American Locomotive Company

By F. E. Bocorselski

The advent of high-speed steel drills necessitated the redesigning of all drilling machinery, as no machine then built could drive a high-speed drill to the limit of its endurance. This gave the drill makers a respite, as, having produced a drill which could not be broken in legitimate service by any machine used for driving it, further progress, so far as cutting capacity was concerned, became unnecessary until the makers of drilling machinery caught up to them.

After carefully considering this condition of affairs, C. K. Lassiter, mechanical supervisor of the American Locomotive Company, drew up specifications for a radial drill having a six-foot arm, which should be capable of driving the best drills to the utmost limit of their capacity. He then selected three machine-tool firms to design and build a sample machine, with the understanding that if a machine proved satisfactory, a substantial order would follow in each case.

Three Remarkable Machines

This put the designers of the three companies on their mettle, and three remarkable machines were produced, all of which proved capable of driving any drill yet produced to destruction, and producing records for drilling which it is hard to realize as actual accomplishment.

Each machine was tested in the works

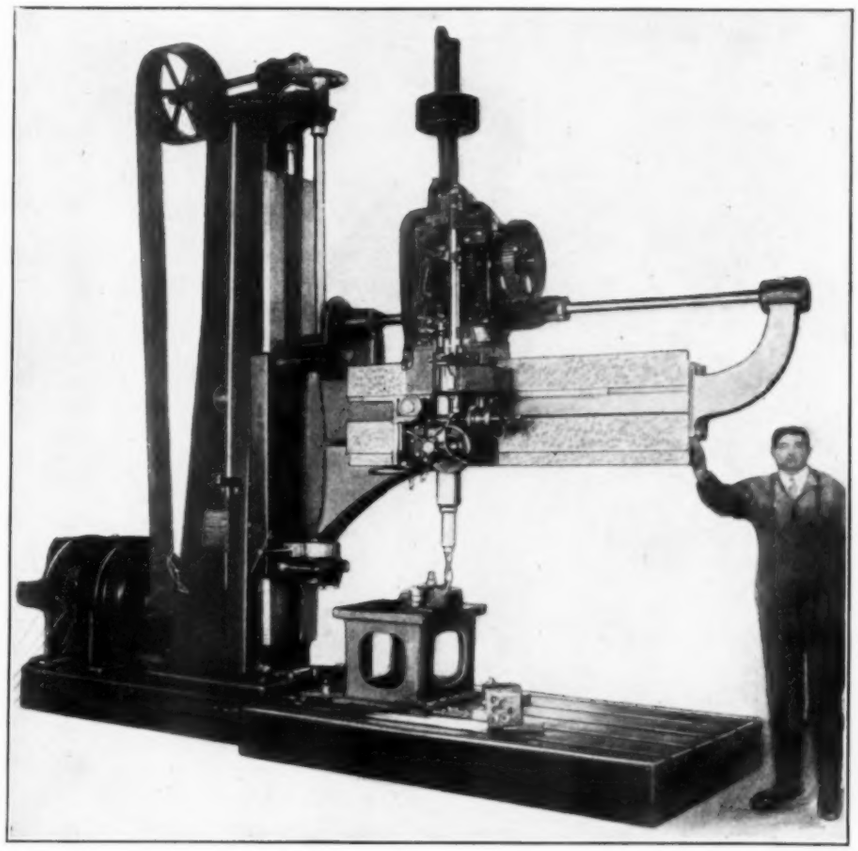


Fig. 1. Baush Radial Drill at Work on Test Block. Other Block Could Not be Drilled Through

*Copyright, 1910, by Hill Publishing Company.

Block No. 1.

Test No.	Drill. Size.	Drill. Make.	Drill. R.P.M.	Cutting Speed, Feet per Minute.	Feed. Per Revolution.	Feed. Inches Drilled per Minute.	Cubic Inches Removed per Minute.	Weight of Metal Removed per Minute, Lb.	Volts.	Amp.	Max. H.P.	H.P. per Lb. per Min.	Remarks.
1	1½	A	290	113	0.0207	6	10.56	2.95	244	77	25	8.48	Drill struck parallel, 242 V., 105 A.
2	1½	A	290	113	0.0207	6	10.56	2.95	244	90	29.5	10.	Drill broke at ⅞" depth.
3	1½	B	290	113	0.0207	6	10.56	2.95	244	73	23.9	8.1	Both lips broke on edges.
4	1½	A	330	107	0.0207	6.83	8.33	2.33	244	76	24.8	10.6	Good condition.
5	1½	A	330	107	0.0207	6.83	8.33	2.33	244	77	25	10.7	Good condition.
6	1 1/16	A Spec.	330	91	0.0207	6.83	6	1.68	248	70	23.2	13.8	Good condition, chipped on edges.
7	1 1/16	A Spec.	330	91	0.0207	6.83	6	1.68	246	75	24.8	14.8	Drill broke at shank.
8	1½	B	330	107	0.0207	6.83	8.33	2.33	246	100	33	14.2	Good condition.
9	1	C	330	86	0.0207	6.83	5.32	1.49	247	85	28	18.8	Drill broke.
10	1½	A	330	96	0.0207	6.83	6.76	1.99	243	84	27.4	13.8	Fine condition.
11	1½	B	330	107	0.0207	6.83	8.33	2.33	246	95	31.3	13.4	Fine condition.
					Steel Block No. 2.								
12	1½	B	330	107	0.0207	6.83	8.33	2.33	244	104	33.4	14.3	2 holes, fine condition.
13	1½	A	290	113	0.0207	6	10.56	2.95	248	110	36.6	12.4	1 hole, fine condition.
14	1½	B	290	113	0.0207	6	10.56	2.95	240	80	25.8	8.74	1 hole, fine condition.
15	1½	B	300	117	0.0207	6.21	10.93	3.06	238	120	38.3	12.5	1st hole, fine condition. 2d hole, drill broke.

Date of test, February 10, 1910.

TABLE 1. TEST OF HIGH-SPEED RADIAL DRILL NO. 1, WITH 20-HORSEPOWER MOTOR.

of the builder by Mr. Lassiter's representative, F. Bucher, to determine the maximum efficiency of high-speed drills in cutting speeds and feeds, and the horsepower required in each case. Special hammered steel billets were provided by Mr. Lassiter to be drilled in each case, these being similar in each instance, although the carbon content was not given but which were approximately 0.70 carbon in each case.

Horsepower Per Pound of Metal

While all three machines were successful, the machine shown in Fig. 1 is considered the most efficient on account of the work performed per horsepower put into the machine. This can be readily compared in all of the machines, as shown in the three tables, by consulting the column entitled "Horsepower per Pound per Minute," which was obtained by dividing the maximum horsepower by the weight of metal removed by the drill per minute.

After a large number of tests, drills of the flat twisted type were selected, and

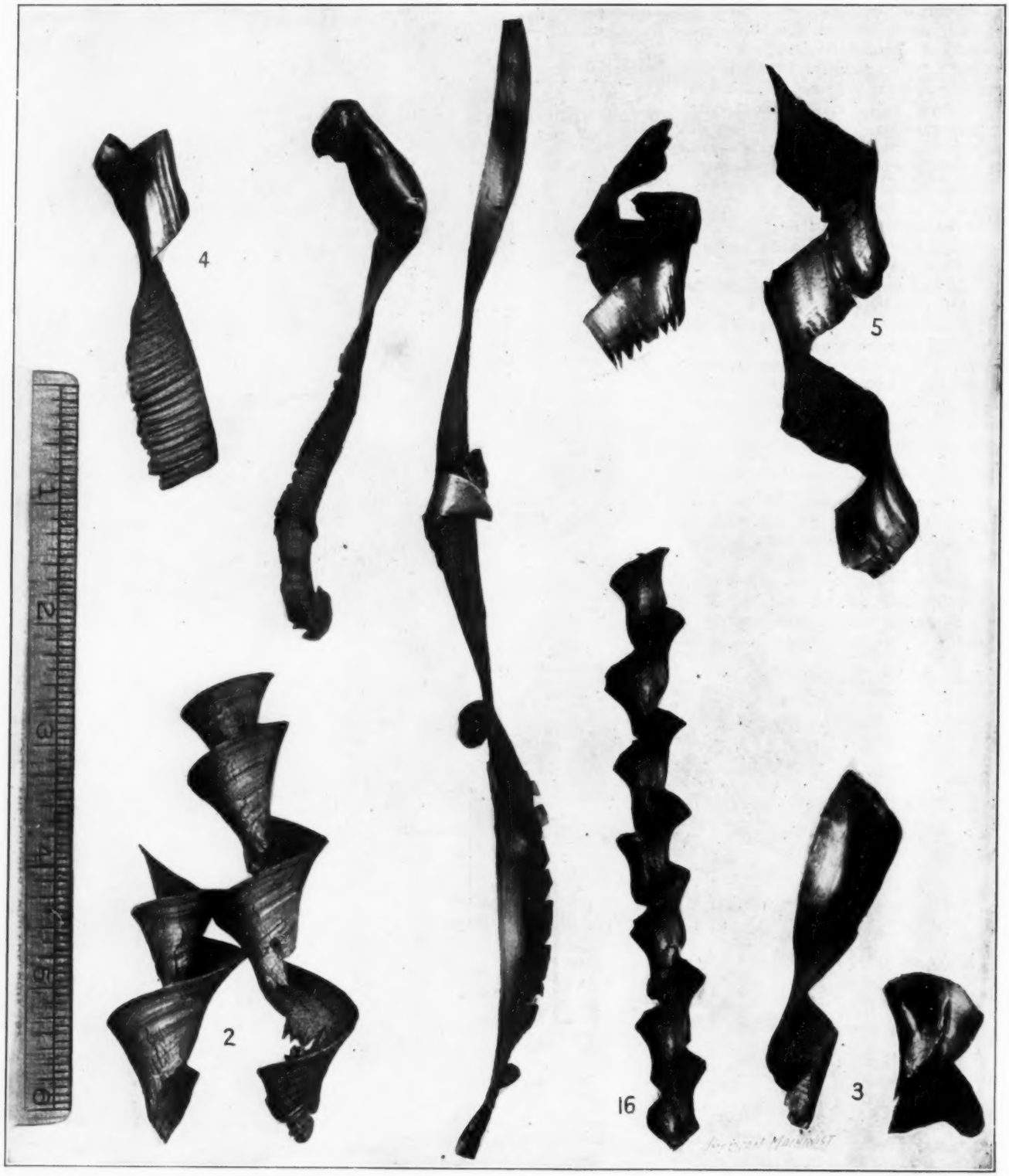


Fig. 2. Interesting Examples of Drilling Chips, About ⅞ Size

Test No.	Drill. Size.	Drill. Make.	Drill. R.P.M.	Cutting Speed, Feet per Minute.	Feed. Per Revolution.	Feed. Inches Drilled per Minute.	Cubic Inches Removed per Minute.	Weight of Metal Removed per Minute.	Max. H.P.	H.P. per Lb. per Min.	Remarks.
1	1½	A	208	61.3	0.022	4.576	4.54	1.27	17.3	13.6	Drilled 2″ deep when drill broke.
2	1½	B	208	61.3	0.022	4.576	4.54	1.27	26.8	21.1	Drilled 6″ deep when drill broke.
3	1½	D	208	61.3	0.022	4.576	4.54	1.27	22.6	17.8	Drilled 7″ deep when drill burned.
4	1½	A	208	68	0.022	4.576	5.57	1.56	24.6	15.8	Drilled 11″ deep when drill broke.
5	1¼	B	208	68	0.022	4.576	5.57	1.56	16.4	10.5	Drilled 6″ deep; drill O. K.; started another hole with same drill when drill broke.
6	1¼	D	208	68	0.022	4.576	5.57	1.56	26.5	17.0	Drilled 7″ deep; drill in good condition.
6 A	1¼	D	208	68	0.022	4.576	5.57	1.56	26.5	17.0	Same drill as No. 6; 7″ deep; O. K. condition.
6 B	1¼	D	208	68	0.022	4.576	5.57	1.56	41.2	26.4	Same drill as No. 6; 9″ deep when drill broke.
7	1½	A	312	123	0.015	4.68	8.24	2.3	31.7	13.8	Drilled 5″ deep; drill in O. K. condition.
						Steel Block No. 2.					
1	1½	A	312	123	0.015	4.68	8.24	2.3	37.5	16.3	Same drill as No. 7, not re-ground; drilled 7″ deep; drill in O. K. condition.
2	1½	A	312	123	0.022	6.86	12.07	3.38	37.5	11.1	Same drill; drilled 3¾″ deep; drill in O. K. condition.
3	1½	A	312	123	0.0323	10.077	17.73	4.97	56.55	11.4	Same drill not re-ground; drilled 3″ deep when fuse blew out; drill in O. K. condition.
4	1½	A	312	103	0.0323	10.077	12.29	3.44	49.5	11.4	Drilled 4″ deep; drill in O. K. condition.
5	1 5/16	B	312	107	0.0323	10.077	13.6	3.81	57.6	15.1	Drilled 4″ deep when drill burned off at point.

TABLE 2. TEST OF HIGH-SPEED RADIAL DRILL NO. 2, WITH 20-HORSEPOWER MOTOR. Date of test, November 8, 1909.

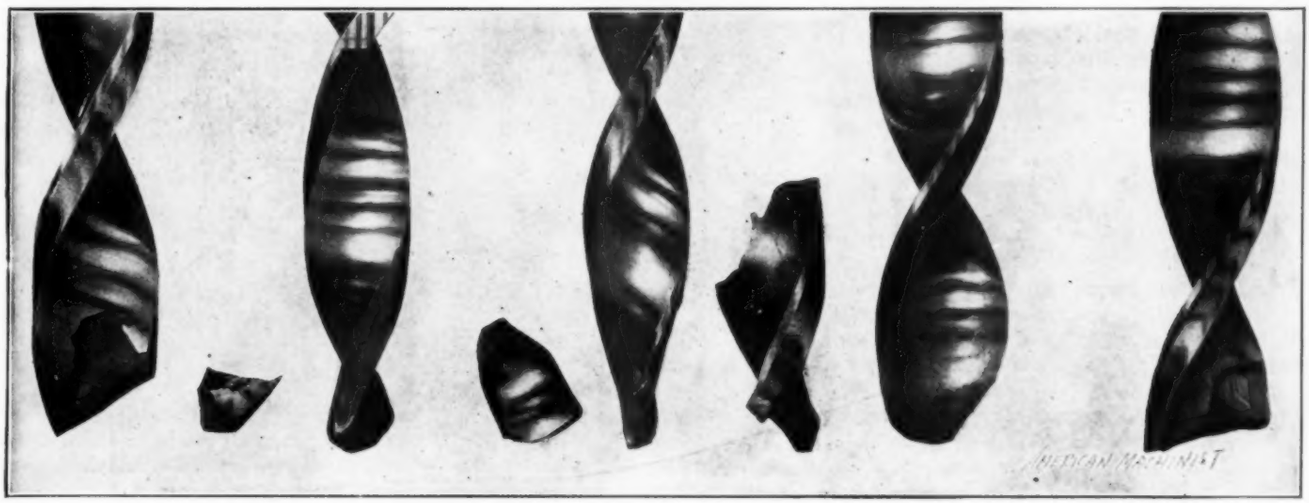


FIG. 3. WHAT HAPPENED TO THE DRILLS USED IN THE TESTS

Test No.	Drill. Size.	Drill. Make.	Drill. R.P.M.	Cutting Speed, Feet per Minute.	Feed. Per Revolution.	Feed. Inches Drilled per Min.	Cubic Inches Removed per Min.	Weight of Metal Removed per Min.	Volts.	Amp.	Max. H.P.	H.P. per Lb. per Min.	Remarks.
1	1½	A	210	60.9	0.025	5.75	5.71	1.6	220	90	26.6	16.6	Drilled 6″; drill O. K.
2	1½	A	210	60.9	0.025	5.75	5.71	1.6	210	90–125	35.3	22.1	Drill broke; lip worn.
3	1½	A, new	210	60.9	0.025	5.75	5.71	1.6	212	95	37.0	23.1	Drilled 6″; drill O. K.
4	1½	A, new	196	64.28	0.025	4.9	5.98	1.67	220	70–100	30.0	18.0	Drill broke.
5	1½	A, new	196	64.28	0.025	4.9	5.98	1.67	215	70–100	29.0	17.4	Drilled 6″; drill O. K.
6	1½	B, new	240	78.72	0.025	6.0	7.32	2.05	215	60–100	29.0	14.1	Drill broke; twisted off.
7	1½	B, new	216	70.84	0.025	5.4	6.59	1.84	212	80–90	25.6	13.9	Drill chipped on point.
8	1½	A, used	226	74.13	0.025	5.65	6.89	1.93	212	80–120	34.0	17.6	Drilled 6″; drill good.
9	1½	A, new	284	110.76	0.0156	4.43	7.80	2.18	210	95–135	38.0	17.5	Drill good; circuit broke.
10	1½	A, same	276	107.64	0.0156	4.3	7.57	2.12	210	95–150	42.0	19.8	Drill good; circuit broke.
11	1½	A, same	276	107.64	0.025	6.9	12.14	3.4	210	130–150	42.0	12.4	Drill good; circuit broke.
						Steel Block No. 2.							
1	1½	A, new	283	110.37	0.025	7.075	12.45	3.48	207	130	36.0	10.4	Drilled 4″; drill O. K.
2	1½	A, same	284	110.76	0.025	7.075	12.45	3.48	207	135–175	48.6	14.0	Drill O. K.; fuse blew out.
3	1½	A, same	284	110.76	0.025	7.075	12.45	3.48	207	135–195	54.0	15.5	Drilled 4″; drill chipped slightly.
4	1½	A, ground	284	110.76	0.040	11.36	19.99	5.59					Drill ¼″; drill broke and belt.
5	1½	A, new	284	110.76	0.040	11.36	19.99	5.59	305	240	66.0	11.8	Drilled 1¼″; belt smoked—shut off.
6	1½	A, same	284	110.76	0.040	11.36	19.99	5.59	305	245	67.3	12.0	Drilled 1¼″; broke; belt burned.

Horsepower of machine running light at full speed 220 v., 15 amp. = 4.4 h.p. less 20 per cent. = 3.52.
Horsepower of machine running light at slow speed 220 v., 7 amp. = 2 h.p. less 20 per cent. = 1.60.

TABLE 3. TEST OF HIGH-SPEED RADIAL DRILL NO. 3, WITH 20-HORSEPOWER MOTOR. Date of test, February 2, 1910.

these are indicated by letter in the table.

Single Reduction with Large Gears

In making the tests of the machine shown the center of the drilling spindle was 53½ inches from the face of the column and 46 inches from the center of the barrel or trunnion, on which the arm swings. The design of the machine only required a single gear reduction, and all gears both bevel and spur, are of steel castings, cut from the solid. The gears are all of large diameter, no gears run over 1200 feet periphery speed and no shaft over 400 revolutions per minute. To this, as well as to the single reduction, is attributed the low power consumption per pound of metal removed.

The machine was equipped with a General Electric variable-speed motor, with a range of from 500 to 1250 revolutions per minute and rated at 20 horsepower. When it is considered, however, that in test 6 of the second series in Table No. 3, the motor developed nearly 68 horsepower, it will be seen that its power rating is decidedly conservative. The machine was driven by an 8-inch double belt, and even this was not proof against slippage. The spindle speeds can be varied from 165 to 330 revolutions per minute, while the feeds are 0.0054, 0.0073, 0.0111, 0.015, 0.027 and 0.031 inch per revolution of the spindle.

The Story of the Chips

Fig. 2 shows some very interesting chips secured from the various tests and which can be identified by number, these numbers corresponding with the tests made.

These chips are shown nearly full size in order to give a better idea of what can really be done in the way of modern drilling. They also show the chips produced by different feeds varying from the large, easy coiled chips from No. 2 to the tightly coiled, heavy chip of No. 16. The long, thin chip in the center was made by the chip following the edge of the drill and taking its curve in that way.

Fig. 4. Why the Drills Start to Break

It was squeezed thin on one edge as can be seen from its frayed condition.

Fig. 3 gives an idea of the condition of the drills after being driven to the breaking point, while Fig. 4 is particularly interesting as it seems to give a clue to the direct causes of drill failure.

Where the Drill Fails First

A careful examination of the chip will show the point of the drill welded fast to the chip, and as soon as this happens the drill ceases cutting at the center, and as it is being continually revolved and forced down by the heavy feed, the steel cannot stand the strain and lets go at the weakest point. In this way the point of the drill seems to be the limiting feature, and though it cuts much more freely by being thinned down, this also weakens it so that it twists out easier than might otherwise be the case.

In all three tests it will be seen that the average feed is about 0.02 inch per revolution of the spindle, while in Table 1 the cutting speed in feet per minute averages higher than in either of the others. How much the effect of this higher cutting speed has to do with the lower power required per pound of metal removed, and how much is due to the use of single instead of double back gearing can be left to the judgment of the reader.

The Condition of the Drills

As a help in interpreting the remarks concerning the conditions of the drills, it is interesting to note that, although a drill would appear to be in good condition as shown, it could very rarely be depended on to drill a second hole, so that generally speaking, a single hole of perhaps 5 inches in depth was about all that could be obtained from the average drill. In one case a 1½-inch drill was forced through 10 inches of metal in one minute, but this required 52 horsepower and used up the drill.

Both cutting oil, which usually contains approximately 40 per cent. of lard oil, and cutting compounds were used, and the best results obtained from the latter. This seemed to preserve the lip of the drill better than the oil, and also reduced the heat to a minimum.

As all of these tests may be termed destructive, either the speeds or the feeds are excesssive, and as high-speed drills cost too much to be renewed after drilling each hole, it is desirable to know what speed and feed can be considered good practice in securing the maximum amount of work from these machines and from the drills used in them.

The Best Speeds and Feeds for Active Service in Steel

For the maximum production and considering the life of drills at the same time, it seems best to run a 1-inch drill about 300 revolutions per minute with a feed of 0.015 inch per revolution; a 1½-inch drill 225 revolutions per minute at a feed of 0.02 inch per revolution. This is based on the experiments with high-speed drills of the twisted type.

A Special Employers' Liability Policy

At the tenth annual meeting of the National Civic Federation, Lewis W. Parker, president of the Victor Manufacturing Company, Greenville, S. C., referred, in an address, to a special form of employers' liability insurance policy, that has been drawn at his dictation and is used by him in his business enterprises.

In reply to a letter asking for information Mr. Parker outlines the provisions of his special policy, to which he seems to have given considerable attention and thought, in these words.

"The policy to which I referred is one issued at a reasonable rate and provides in effect as follows:

"(1) That in cases of all accidents the employer has full right of settlement and adjustment without regard to or consultation with the insurer.

"(2) Where adjustment is made for less than $500 the employer stands the whole burden.

"(3) Where settlement is made for over $500 the insurer stands three-fourths of the excess over $500 and the employer one-fourth.

"(4) Where suit is instituted, the employer defends the suit and has full right of adjustment without consultation with the insurer, but insurer has right at any time to settle or adjust any case or claim without consultation with the employer, provided that in such case the insurer pays the entire amount.

"The object of this policy is to give to the employer the full right of adjustment with his employees, and since I have taken out such a policy I have had few lawsuits and have been able in almost all cases to satisfactorily adjust matters with the employees, to their benefit and at the same time to mine, and to the maintenance of pleasant relations with them."

Lathe Building Operations in Well Equipped Shop

Methods and Tools Used in Machining and Testing Parts

By F. A. Stanley

Some methods and tools employed in machining and testing lathe beds, saddles, heads, etc., at the works of the Lodge & Shipley Machine Tool Company, Cincinnati, Ohio, are illustrated by the accompanying halftones and line engravings.

In planing the beds of the lathes built by this concern it is customary to take the well seasoned casting, rough off the bottom of the bed, turn it over, rough off the top, loosen up the straps to remove all strains due to the clamping-down process and finish the top, including the shears, rack seat, and inner bearing surfaces, with two cuts, the final cut being a very light one. Several beds are planed simultaneously on the long planer platen. A number of gaging fixtures for the top of the bed are shown in Fig. 1, resting upon the shears.

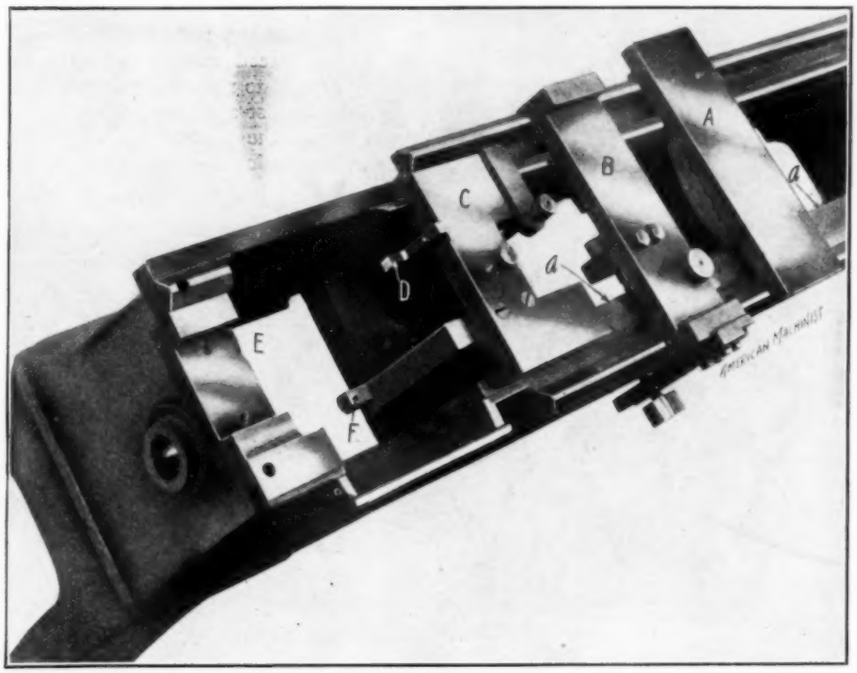


FIG. 1. GAGES FOR TESTING PLANING OF LATHE BEDS

PLANER GAGES

The gage *A* at the right is a half templet of cast iron, which may be reversed to test the corresponding sides of the front and back ways, and upon the application of this gage to the work any variation from the correct center distance is revealed at once. The gaging fixture in the middle *B*, has a series of nurled-head screws, which test the planing of the flat ways at the front, the seat for the lead-screw bearing, the straight inner bearing surface at *a* against which a vertical surface upon the carriage of the Lodge & Shipley lathe takes a bearing, as indicated in Fig. 2. This carriage, as will be recalled, slides upon V's at front and rear and also on a flat way at the front, besides taking the bearing along the inner surface as in Fig. 2, so that the carriage bridge is rightly supported under the action of the cut.

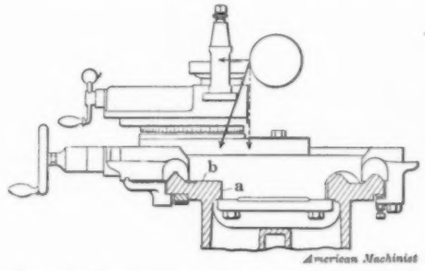


FIG. 2. BEARING OF LODGE & SHIPLEY LATHE CARRIAGE

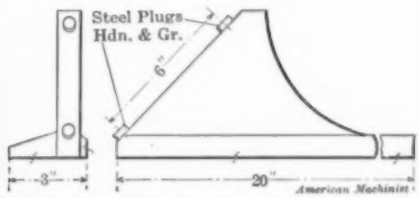


FIG. 3. ANGLE GAGE FOR SETTING PLANER HEAD

HOW THE GAGES ARE USED

In testing the surfaces referred to above, by means of the nurled-head screws in fixture *B*, Fig. 1, a paper feeler about 0.002 inch thick is placed under the flat end of the screw and the latter run down until the flat under-surface of the head is in contact with the fixture. The feeler, if the planed surface is correct within the required limits, is pinched between the surface and the end of the screw, but still may be withdrawn readily, with the fingers, showing that there is a very slight clearance between the screw and the bearing surface under inspection.

Gaging fixture *B* has also at one side a hardened-steel piece projecting under

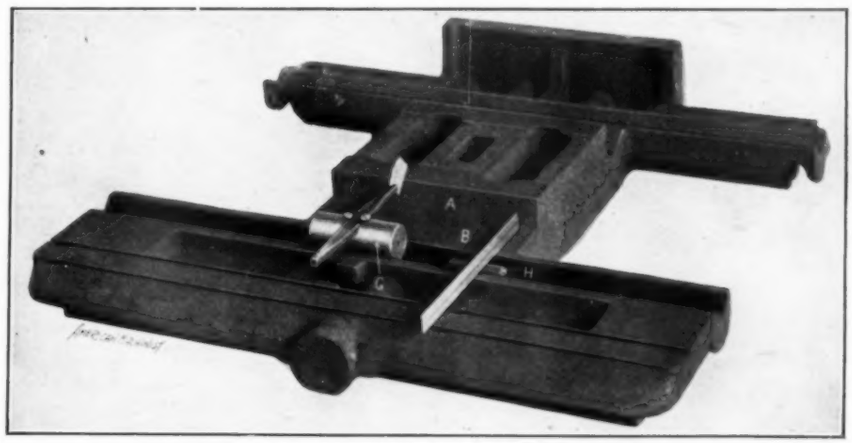


FIG. 4. TESTING CARRIAGE BEARING SURFACES

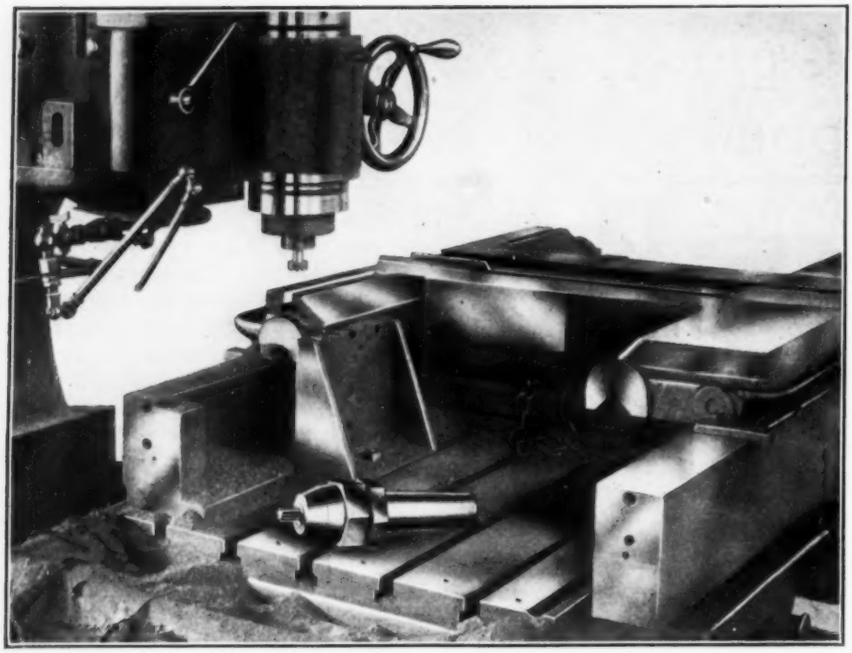


FIG. 5. MILLING T-SLOTS IN CARRIAGES

the front of the bed and serving as a gage for the rack seat. This gaging member is not visible in the photograph. Gage *C*, which has two screws for testing the vertical position of certain seats under the head, has also several setting points, by means of which the planer tools are adjusted to cut to the proper depth and also to finish the sides of seats at the head end of the bed. Thus the gage point *D* gives a setting of the tool for finishing the seat *E* for the bearing under the head for the sliding tumbler shaft and *F* locates the tool for planing off a bearing surface for a box carrying the inner end of the change-gear shaft and corresponding in position with the hole in the outer end of the bed forming the outer bearing; a square-nosed tool may also be set at the side of gage *F* for correctly locating a groove to receive the tongue under the inner bearing just referred to.

ANGLE GAGE FOR SETTING PLANER HEAD

A handy gage for adjusting the planer head to finish the V's to the exact angle required is shown by the sketch, Fig. 3. This is simply a casting about 20 inches long, having at one end a vertical projection in the sloping face of which are fixed two steel plugs which are hardened, and, after insertion, accurately ground and lapped to the exact angle required for the side of the V. The plugs are about 6 inches between centers and the master angle thus formed is so much larger than the V that it is an easy matter to adjust the head correctly by setting the tool to the faces of the two plugs. The bottom and right-hand side of the gage are planed and scraped and in locating it upon the bed to be finished, it is simply placed across the ways and swung around to right angles by bringing the side against a square. This gage is used on all the planers for setting the heads for planing the ways of beds, saddles, heads or footstocks. It greatly

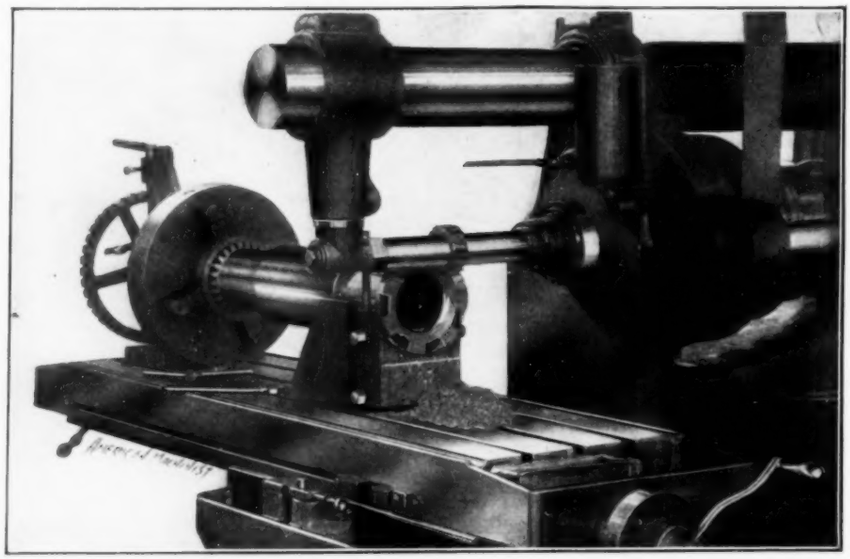


FIG. 7. MILLING CLUTCH TEETH IN END OF SLEEVE

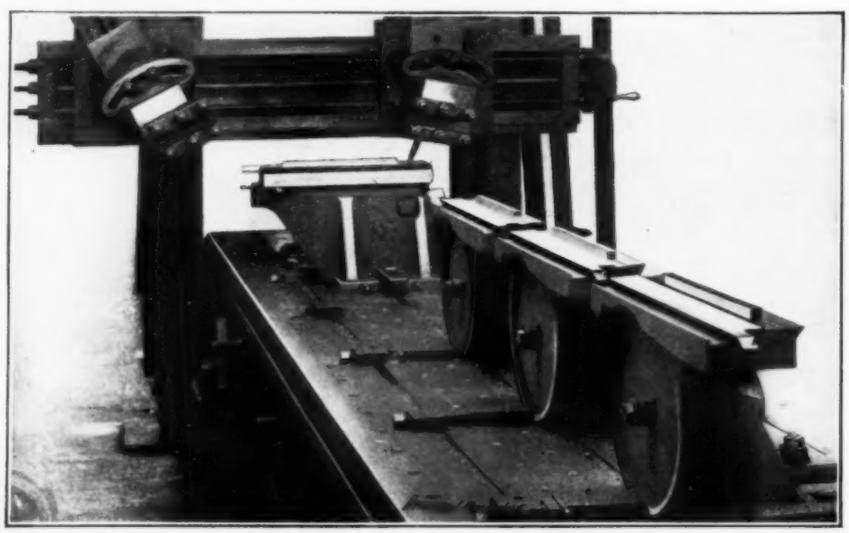


FIG. 6. A ROW OF PLANER FIXTURES WITH WORK IN PLACE

facilitates the production of correct surfaces, and this, with the care used in the actual planing operations, reduces the work of scraping to a minimum.

GAGING SADDLE BEARING SURFACES

Reference has already been made to the bearing surfaces under the carriage. For testing these as finished on the planer the devices shown in Fig. 4 are utilized. The V's are planed the correct distance apart in the same way as the ways on the bed. The flat way *b*, in the front and the bearing surface *a*, Fig. 2, must be correctly located in reference to the V's, and these are tested as in Fig. 4. The gage at *G* consists of a round plug which is dropped into the front V in the saddle, while the wing placed crosswise of the plug should just contact with the piece of tissue paper resting against the vertical bearing surface as indicated. The

outer end of the arm fixed crosswise of the plug serves, by the way, as a setting gage by which the square-nosed tool is located for planing the groove under the carriage to receive a locating tongue upon the top of the apron.

The flat surface *b*, Figs. 2 and 4, is tested in relation to its V by placing plug *H*, Fig. 4, in the V and resting a scale or straight-edge upon this plug and the flat surface. The plug is ground to an exact diameter so that its top shall coincide with the plane of surface *b* and any inaccuracy here is detected by rocking of the straight-edge in the test.

Milling T-Slots in Carriages

For milling the T-slots in the wings of carriages, the fixture in Fig. 5 is used. This is shown on a large Becker vertical spindle miller and is used for various sizes of carriages. The rear part of the fixture is secured to the table and has a guide projecting toward the front upon which the movable part of the fixture may be adjusted to accommodate different sizes of work. The carriage is located square on the fixture and instead of being strapped down is secured simply by gripping at the ends so that there is no danger of distortion, and the work is readily put in place and removed when milled. Two cutters are used in forming the slots. First, an end mill is run into the metal taking one cut the full length of the slot and then back again, thus cutting the narrow part of the slot to width and also cutting deep enough to allow the T-slot cutter to enter properly.

The machine is shown with a T-slot mill in place and with one of the slots completed. It will be noticed in the photograph that one of the carriage wings at the front has not been slotted, showing clearly how these slots are cut from the solid metal. The saddle shown is for a 27-inch lathe.

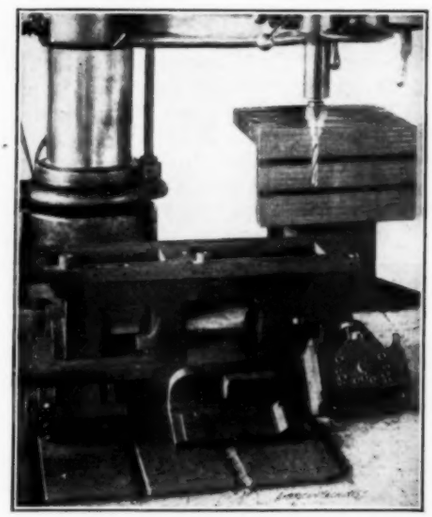


Fig. 8. Drill Jig

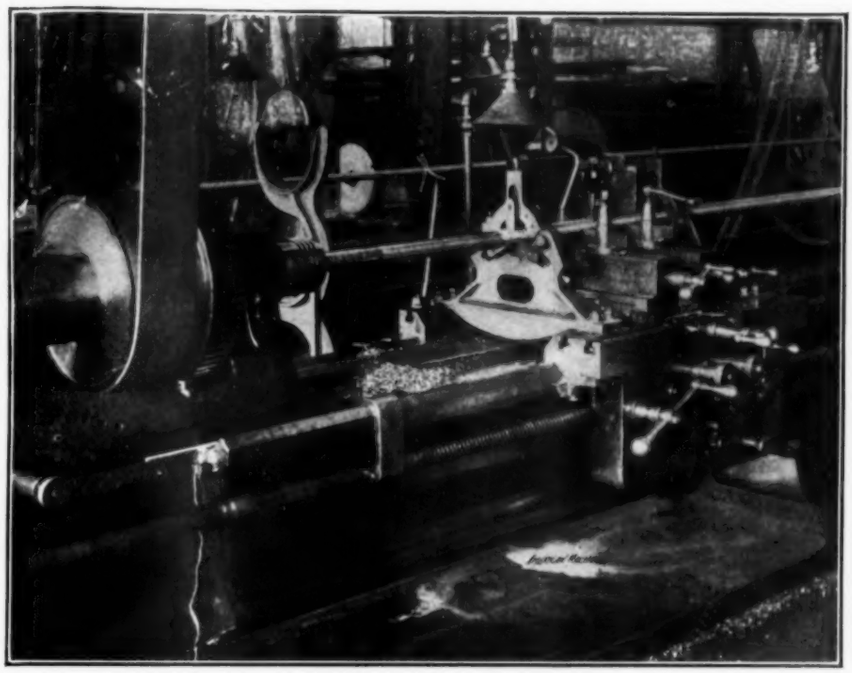


Fig. 9. Special Lathes for Cutting Long Lead Screws

A String Planing Operation

On the Gray planer in Fig. 6, is shown a row of fixtures holding a series of cross slides used on the "Marvel" lathe for carrying the rotating tool holder. These cross slides, like the saddles, heads and other lathe parts, are planed up in quantities, one or two rows being placed the whole length of the platen. In the case illustrated several of the fixtures are shown as located for planing the bottom surfaces of the slides and gibs, while at the front of the platen one of the fixtures has been turned crosswise to show the method of planing off the end of the slide. These cross slides are provided with taper gibs, having 3/16 taper per foot, and the gibs are finished after fitting in place in the slides. First, however, the surfaces of the gib which fit in the cross slide are planed and the corresponding surface in the slide itself is planed at the proper angle for the taper side of the gib by swinging the fixture against locating devices in the platen slots. The gibs are made to a nice sliding fit in the cross slides and in order that they may hold firmly while

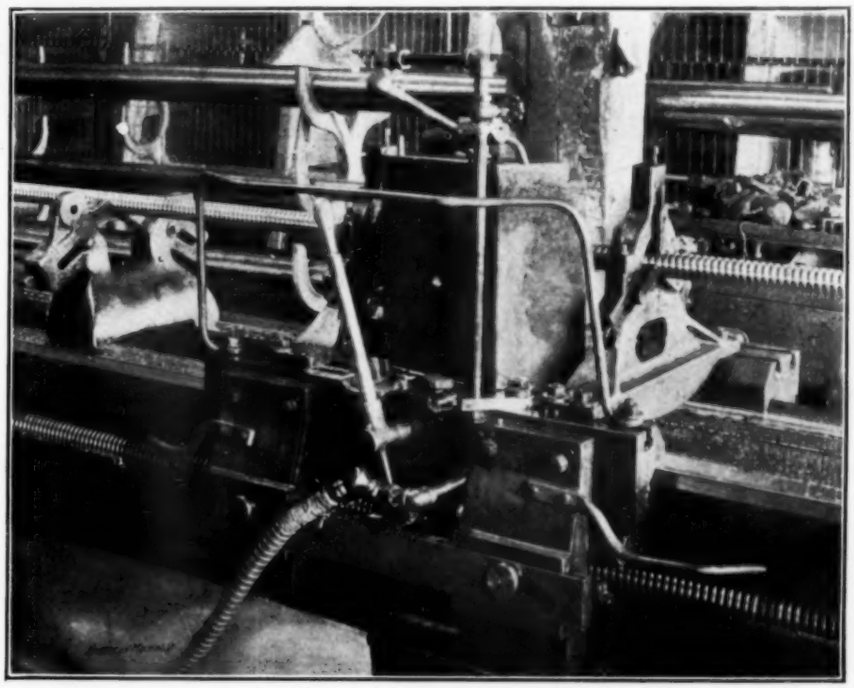


Fig. 10. Rear View of Lathe for Cutting Long Lead Screw

FIG. 11. APRON ASSEMBLING BENCH

APRON DEPARTMENT.
APRON

Inspect finish of corners.
" all oil holes.
" half nuts for fit on lead screw.
" half nut cam and handle unlock free from lead screw.
" reverse lever plunger for fits of hole in apron.
" reverse plunger lever.
" reverse knob for fit of plunger.
" friction knurls for proper throw of one half turn.
" rack pinion fit in rack.
" if hand wheel runs true outside diameter and hub.
" clamping screws for tight fit.
" rack pinion to extend full width of rack.
" knurls for good fit.
" first pinion stem nuts for fit of threads.
" intermediate stud nuts for fit of threads.
" friction stem for fit of nuts.

American Machinist

FIG. 12. INSTRUCTION CARD OVER APRON ASSEMBLING BENCH. ACTUAL SIZE ABOUT 8x10 INCHES

being finished upon the bottom and beveled surfaces, thin paper is placed under them when they are pushed into position. As they are tongued at the side as seen in the illustration to fit in corresponding grooves in the cross slides, the extra pressure secured by the presence of the paper holds them from slipping under the action of the cutting tool. While the bevel side of the gib is being planed down the holding fixtures with the cross slides are swung back parallel with the platen.

AN INDEX MILLING FIXTURE

The fixture illustrated in Fig. 7 is an indexing device used on a No. 4 Cincinnati miller for cutting clutch teeth in the end of the sleeve of the "Patent" and "Marvel" lathe heads. The photograph shows this fixture so clearly that little explanation is required. The index mechanism consists simply of a notched wheel with a locking bolt actuated by a short lever, and the cuts are taken straight across the end of the sleeve by feeding the table vertically to carry the work past the cutter. Two cuts are taken for each tooth, the side of the cutter being set on the center line of the work and the latter indexed around twice to complete the operation.

DRILLING JIGS

Naturally there are many interesting drill jigs used in these shops, and a few of them are shown under the radial drill in Fig. 8. A jig is shown in position on the lathe head for drilling the holes by which the lathe head is secured in place. This jig is provided with a V and flat way cor-

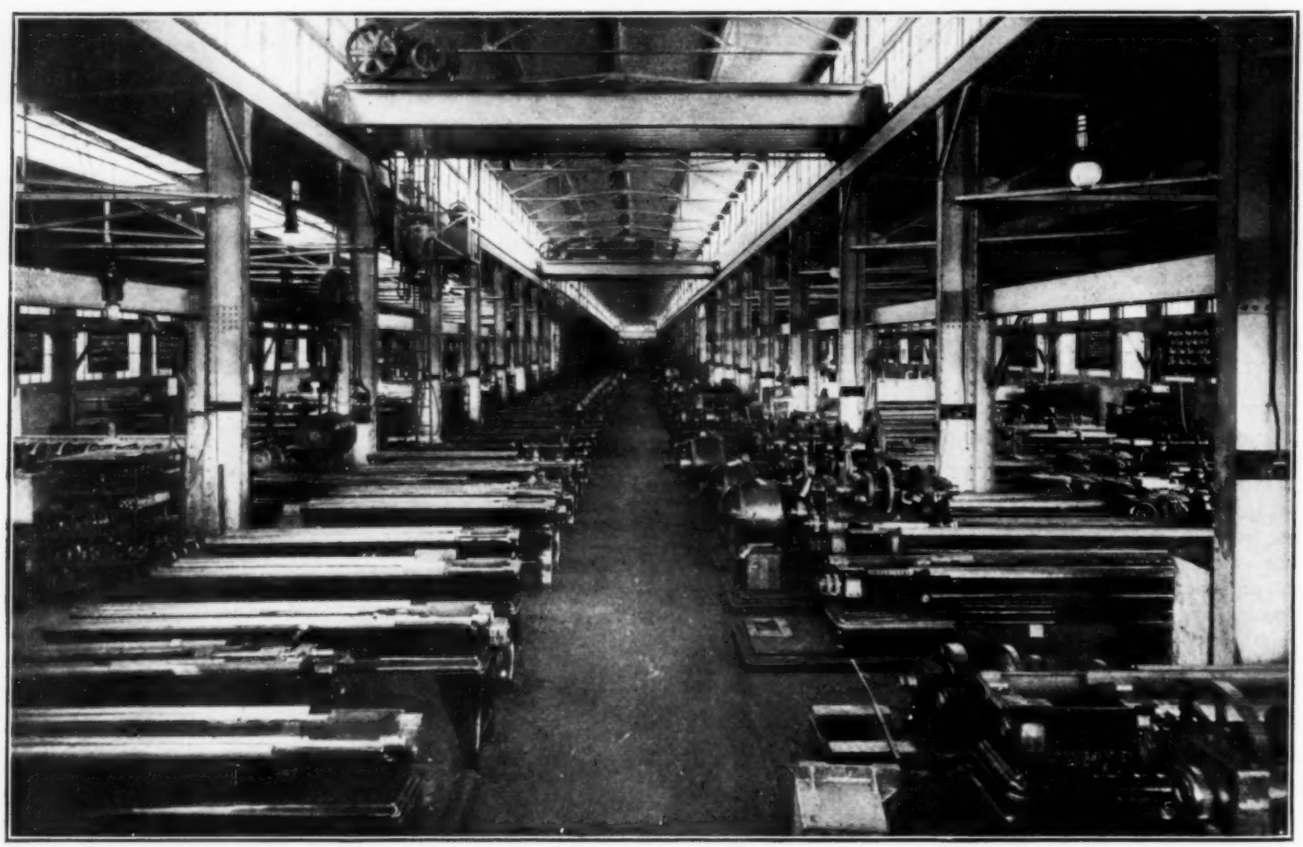


FIG. 13. GENERAL VIEW OF ERECTING FLOOR SHOWING BLACKBOARDS OVER EACH MACHINE

responding to the shears on the bed, so that it is located on the head in the same way as on the bed in order that the position of the holes in the two members shall coincide exactly. The jig answers for several sizes of heads, and the drill bushings may be located in different holes to suit the work.

The smaller jig at the right is for drilling spindle caps; the one at the left is located in the seat for the cap and used for drilling cover holes; the jig in the middle of the group is located by the ways under the head and the bushing in the depending lug guides the drill for putting in a hole for the reversing plate at the end of the head.

Lead Screw Machines

The lathes in Figs. 9 and 10 were built at this shop for cutting long lead screws, the larger of the two machines having a 24-inch swing and both cutting lengths up to 24 feet at one setting. The head has a large hollow spindle and the work is held by a draw-in collet actuated by a handwheel at the rear end of the spindle. The drive is by a 6-inch belt passing over a large single-step pulley and driven from a six-speed countershaft.

The carriage is equipped with two cross slides and carries two tools, each independently adjusted by a screw with micrometer collar; ordinarily each tool takes a cut 0.010 inch deep, or a total reduction is made at each pass of the carriage of 0.040 inch. There are two follower rests attached to the carriage near the threading tools and a third rest is placed behind the work and between the two tools. In cutting long work a steady rest is placed midway of the length of the bed, and this, of course, is removed from the path of the carriage and placed behind it when the carriage reaches the middle of the bed. The lead screw which traverses the carriage during the cutting operation is located at the rear of the bed. It is about 2¼ inches diameter and is a very accurate screw. As illustrated in Fig. 10, it is supported in shoes which inclose the lower half of the screw and are spaced at intervals of about 20 inches center to center, the shoes being approximately 12 inches long and leaving, therefore, only short portions of the screw unsupported.

There are two nuts for the lead screw, one at each end at the rear of the carriage, each being a half nut which is dropped into engagement with the lead screw and released from the screw by means of the vertical lever shown. The lower end of the latter is in the form of a segment engaging with rack teeth upon a sliding bar slotted obliquely at each end so as to elevate, or lower, the half nuts when the lever is operated. The carriage is returned quickly after each cutting stroke by means of a screw at the front of the lathe which is driven rapidly by a special countershaft located over the tail end of the bed, so that very little time is lost in running the carriage back after each cut. The quick return countershaft has reversing pulleys, so that the carriage may also be traversed rapidly toward the head when desired in making adjustments for cuts, etc. The method of supplying lubricant to the test tools is brought out clearly in the illustration.

Instructions for Assembling Various Parts

Not only is care taken throughout the building of the lathes to insure interchangeability of parts, but also every effort is taken to assure all the members entering into the construction of carriages, aprons, heads, etc., being properly put together. A feature in this department is a card upon which in large characters are printed various points which must be looked after during the assembling process. Fig. 11 represents a bench upon which aprons are being assembled, and upon the back of which one of these placards is plainly visible. The items upon this card are reproduced in Fig. 12. Similar instruction cards are employed for other parts of the works.

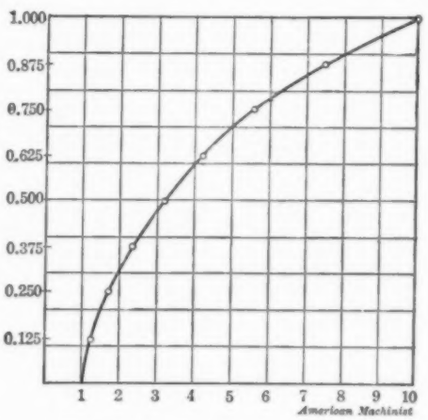
The general view in Fig. 13, looking down the erecting floor, illustrates a blackboard scheme by means of which the workmen upon each lathe are kept informed of the date of delivery for that particular machine, the type of machine as a whole, the character of attachments, which are required on the order. In this way every man connected with the work, as well as the foreman, has before him a constant reminder of the date when the machine must be completed. The blackboards are about two feet long, and, as plainly shown in the halftone, are hung directly on the two rows of lathes extending down their department.

Logarithms on a Desert Island

By Con Wise

Suppose you were cast away on a desert island and had left your logarithm table behind? That is a question often asked when hunting an excuse for not using logarithms. The use of logarithms, or even of the slide rule, in shops is so limited that it is safe to say that not one man in a hundred uses either and not one in a thousand knows the principle on which they depend. When we come to realize how simple the whole thing is and how handy in certain cases their use becomes, it seems a pity that more men do not investigate and use them.

Let us see what would be the process of building a table of logarithms if we were cast away on a desert island with nothing but a strip of beach and a pointed stick. Of course the only reason for making up a table of logarithms under such conditions would be to while away the time while the cannibals were deciding whether to fricassee you or cook you in oil, but the illustration will do. A table of logarithms is quite a book, as usually published, so the proposition looks a little discouraging. We can begin the task, however. First, let us start on the assumption that we remember that the logarithm of a number is the exponent of 10, which applied to 10, produces that number. For example, the logarithm of 100 is 2, because $10^2 = 100$, of 1000 is 3 because $10^3 = 1000$ and so on.



Curve for Interpolation of Logarithms

Numbers from 1 to 10 have logarithms less than 1; between 10 and 100 less than 2 and so on, but the fraction or "mantissa" is the same for corresponding numbers as 5, 50 or 500. Therefore, all that is necessary is to get the mantissa for all numbers between 1 and 10. In the time during which the savages are deciding whether we will taste better served with apple sauce or baked beans, we cannot get all of them, but we can get enough to show the method.

Naturally enough we work backward. Take the square root, the fourth root, etc., of 10 and set down a table like this:

$$1.33 = 10^{\frac{1}{8}}$$
$$1.78 = 10^{\frac{1}{4}}$$
$$3.16 = 10^{\frac{1}{2}}$$
$$10.00 = 10^{1}$$

To get a few more

$$10^{\frac{1}{8}} \times 10^{\frac{1}{4}} = 1.33 \times 1.78 = 2.37 = 10^{\frac{3}{8}}$$
$$10^{\frac{1}{8}} \times 10^{\frac{1}{2}} = 1.33 \times 3.16 = 4.21 = 10^{\frac{5}{8}}$$
$$10^{\frac{1}{4}} \times 10^{\frac{1}{2}} = 1.78 \times 3.16 = 5.62 = 10^{\frac{3}{4}}$$
$$10^{\frac{1}{8}} \times 10^{\frac{3}{4}} = 1.33 \times 5.62 = 7.5 = 10^{\frac{7}{8}}$$

If the chef is still undecided you can work out the 16th root by taking the square root of 1.33 and in the same way

get a finer division. This may be continued just as far as time and patience will allow.

Arranged in a table it looks like this

Number.	Logarithm.
1.33	0.125
1.78	0.250
2.37	0.375
3.16	0.500
4.21	0.625
5.62	0.750
7.5	0.875
10.0	1.000

We are more likely to want to get the logarithm of an even number, such as 4, than 4.21; so to get it readily we lay out the annexed diagram in the sand with our pointed stick and plot the curve shown. On that we may look up any particular logarithm that we may want. This curve, if drawn with care from the few points computed above, is fairly accurate to two places of decimals. Logarithm 4 from the curve appears to be just 0.6, while it is really 0.60206. Logarithm .7 appears to be about 0.84, while it is really 0.8451.

The worst feature of a slide rule shows up plainly from this curve. The range of logarithms of 1 to 2 covers 0.3 of the scale, while between 9 and 10 covers only about 0.03 of the scale. Work done in the early part of the scale is about 10 times as accurate as at the other end.

Lay Out of Intermittent Gears Simplified

By Chas. H. Logue

Intermittent gears are designed to allow the driven gear or follower one or more periods of rest during each revolution of the driver. This may be accomplished in a rough manner by cutting out a number of teeth in the follower as illustrated in Fig. 1, but the cut and try method must be employed to obtain a definite ratio. This type of intermittent gear is seldom used, there being nothing but the spring *B* to keep the follower from moving during a period of rest, and the first tooth of the driver enters contact in a very uncertain manner, it sometimes being necessary to shorten the first tooth in the driver to prevent it from striking the top of the first tooth in the follower.

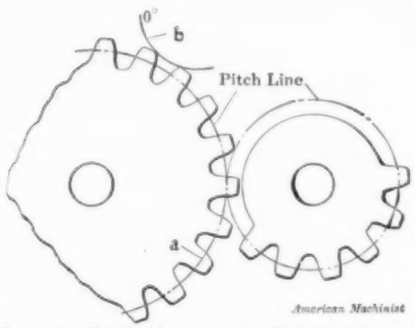


FIG. 1. POOR DESIGN OF INTERMITTENT GEARS

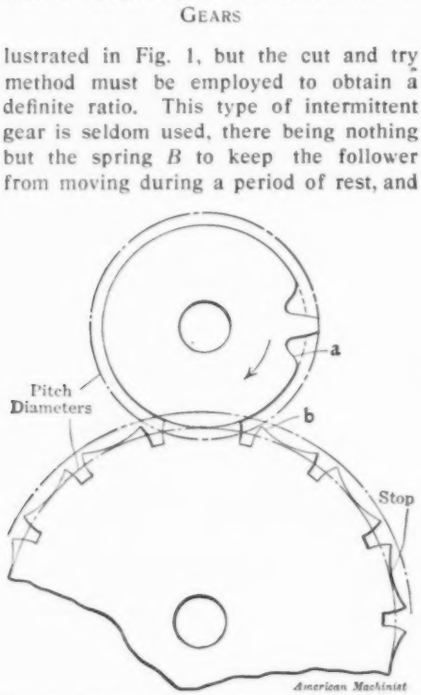


FIG. 2. INTERMITTENT GEARS OF VARYING RATIOS

The proper design of intermittent gears is not as difficult as it first appears. The pitch and outside diameters are found as for an ordinary spur gear, the pitch desired must correspond to an even number of teeth. The blank space on the driving gear is milled to the pitch line, and the stops in the follower are cut by a cutter of a diameter corresponding to the pitch diameter of the driver. If no such cutter is at hand, use the nearest to that size to rough out the stops and finish them with a fly cutter which can be set to any desired radius.

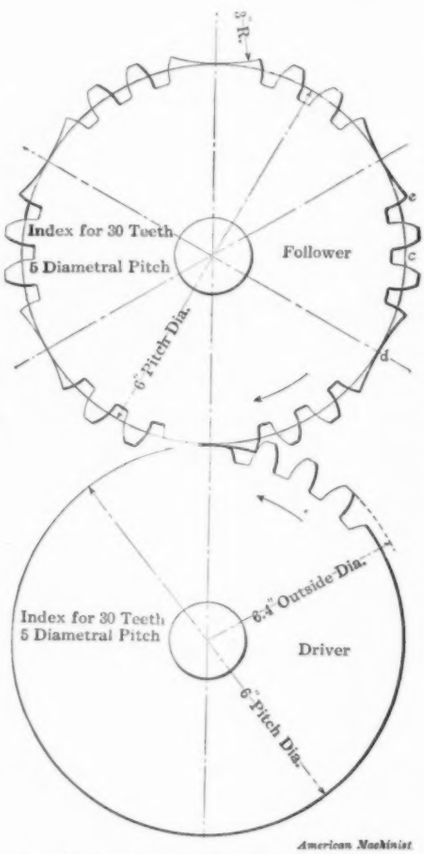


FIG. 3. INTERMITTENT GEAR WITH SIX STEPS

It is well not to have the gears too near the same size, the driver should be the smallest in order to secure all the contact possible in the stops.

The simplest form of intermittent gear is shown by Fig. 2, the follower being moved but a short distance for each revolution of the driver. It will be noticed that a small amount of fitting will always be required at the point *a* to allow the point of the stop to clear.

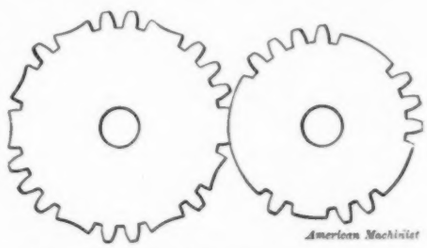


FIG. 4. OTHER INTERMITTENT GEARS

A more complicated drive is shown in Fig. 3, the follower being moved one-sixth of a revolution for each revolution of the driver. Each of these gears is turned up as for a spur gear of 30 teeth 5 diametral pitch. The cutting operation would be as follows: Index for 30 teeth; cut the first three teeth, then index for two teeth without cutting, and so on around the blank. The six stops are then milled, with a cutter 6 inches in diameter, to a depth of 0.2 inch, or the addendum of the gear, which completes the follower. Four teeth are then cut in the driver, and the remainder of the blank milled to the pitch line. A little filing and the gears are complete.

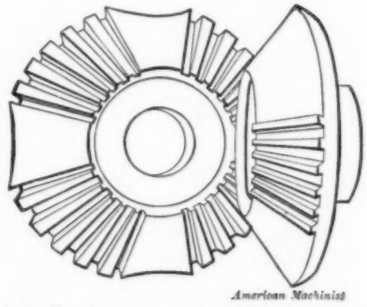


FIG. 5. INTERMITTENT BEVEL GEARS

A still simpler method of cutting these gears, and one that avoids the necessity of first laying them out, is as follows: Drop a cutter equaling the pitch diameter of the driver into the blank of the follower, to the depth of the addendum a

the points stops are desired. It is not at all necessary that they be equally spaced as will be seen by referring to Fig. 4. Then cut the first tooth at a point midway between two of the stops, and continue cutting toward one of the stops until the point of the stop touching the outside circumference of the blank is cut away, or in other words, until there is no blank space on the gear between the last space cut and the point of the stop. The same number of teeth are then cut in the opposite direction until the same condition is met. If the stops are evenly spaced the cutting of the remaining teeth is a simple matter. If the stops are not evenly spaced the first tooth for each group must be located between each stop. The same number of teeth are then cut in the driver as there are spaces in the follower for each group and the remainder of the blank milled to the pitch line. For a pair of gears such as shown in Fig. 3, the cutting of the teeth by this process will be a simple matter.

A still more complicated drive is shown by Fig. 4, but this gear is just as easy to cut as the foregoing. The cutting of internal intermittent gears is a counterpart of the above. Bevel gears, while being more difficult to cut, are governed by the same rules. See Fig. 5.

The Effect of Silicon in Steel

By F. F. Lake

Silicon is the second most important element in the solid part of the earth's crust, oxygen being first, and forms 27.21 per cent. of it. It is never found in the free state in nature, but, having a powerful affinity for oxygen, it occurs chiefly as silicon dioxide, SiO_2, which is commonly called silica, and in the form of silicates in combination with oxygen or such metallic elements as sodium, potassium, aluminum and calcium. Silica will neutralize every base it comes in contact with when molten, and all metallurgical slags are the silicates thus formed. The silicon used in steel making has to be separated from the oxygen of the silica and united with iron to make ferro-silicon. Sometimes manganese is added to this to form ferro-silicon-manganese.

Many contradictory statements have been made as to the effect of silicon on steel. When the silicon is left in the pig iron from the blast furnace, it is an indication that the metal has been blown too hot, and as the iron has not been completely converted into steel the metal has a brittle character. The percentage varies considerably, according to the heat of the charge, and this causes irregularities which may account for the difference of opinion. To get the best results in the steel the silicon should be eliminated as much as possible from the iron and a definite quantity added in the form of high percentage ferro-silicon, or ferro-manganese-silicon. This gives a very different effect from that of silicon left in the blast-furnace iron.

If silicon is added to steel in such a manner as to cause it to enter into solution as silicide, it confers upon the metal valuable properties; but if it forms a silicate it is injurious in many ways, even to the point of being dangerous. This latter seldom occurs, or at least occurs only to a slight degree, as the silicates of iron, manganese, etc., dissolve into each other very readily and form a slag; although manganese silicate probably occurs more frequently and causes more failures in steel than is generally supposed.

Silicon having a great affinity for oxygen it siezes this wherever found, and carries it off to the slag, whether in the form of gases, oxides or dissolved oxygen. This prevents the formation of blow holes and makes the steel harder and tougher. Thus it is better able to withstand wear or crushing from continual pounding. This is only so, however, when the silicon has been eliminated as far as possible from the pig iron and new added to the steel bath in the form of ferro-silicon or silicon speigel. Otherwise the steel is liable to show brittleness and irregularity of percentage.

One steel maker found that if the percentage of manganese was 5.2 times the percentage of silicon and the multiplicand made to equal a percentage in the steel of 2.05 the metal would be entirely free from blow holes, but the pipe would be large; if the total was made to equal a percentage of 1.66 the pipe would be smaller and numerous minute blow holes would appear, but not enough to harm the steel for the use to which it was to be put. He also found that 0.0184 per cent. of aluminum would give the same result as the 1.66 percentage of manganese and silicon.

In the bessemer converters the silicon increases the temperature of the bath, which gradually decreases as it is blown out. Thus the lower percentage of the silicon in the pig iron the shorter will be the blow, and below 1 per cent. of silicon is dangerous, as it does not give time enough for the removal of the impurities. At the end of the blow 0.2 per cent. of silicon is added to rid the bath of the gases. Thus the percentage of silicon is usually under 0.2 in bessemer steel, and for steel rails many engineers are limiting it to 0.1 per cent.

During the "killing" in the crucible process the steel absorbs silicon from the crucible and thus becomes sound by throwing off the gases. The graphite crucibles used in this country give up more silicon than the clay crucibles used in Europe, and consequently allowances have to be made when charging. Too long "killing" makes the steel harsh, brittle and weak, owing to its absorbing too much silicon, which is liable to be retained in steel in the form of silicates. Crucible steels nearly always contain more than 0.2 per cent. of silicon.

The influence of silicon on the results of quenching is similar to that of carbon in many ways. It is also dependent upon the co-existing amount of carbon and manganese. It neutralizes the injurious tendency of manganese, and it is difficult to obtain silicon in steel without the presence of manganese.

An increase in the percentage of silicon slightly raises the tensile strength and lowers the elongation and reduction of area. Up to a content of 4 per cent., silicon increases the tensile strength about 80 pounds per square inch for every 0.01 per cent. Beyond this amount a weakening of the metal seems to take place. Without a considerable percentage of manganese, silicon steels show very low shock resistance, whether annealed or quenched. With 0.20 per cent. of silicon the tensile strength is increased about one-third more than 0.01 per cent. of carbon would increase it. Beyond a content of 5 per cent. silicon steels are but little used for structural purposes.

Steels containing a little less than 1 per cent. of carbon and from 1 to 2 per cent. of silicon have been used quite successfully for hard tool steels. Below a content of 1 per cent. silicon ceases to have an influence on quenching and the metal may be classed as a special carbon steel. Some makers of steel try to keep the silicon as low as possible, but many of the best steels contain from 0.20 to 0.80 per cent. With the carbon content low the silicon may be raised to a fairly high figure, but with the carbon high the silicon should be kept low. It should also be kept low when the phosphorus is high.

Silicon steels are extremely fibrous with a remarkable resistance to shock in the direction of lamination, but practically no resistance in a direction perpendicular thereto. This quality makes them especially adapted for leaf springs.

Jamestown, N. Y., is planning to celebrate its centennial beginning on August 29 and ending on September 4, 1910. There are to be industrial exhibits, emphasizing those lines in which the city is prominent.

A Central Tool Dressing* Plant in a Navy Yard

Methods of Heating, Cooling and Grinding Successfully Applied

By W. H. Taylor

The use of the instruction chart for blacksmith and forging shop appliances is further shown in Figs. 6, 7, 8. The method of procedure and description of the apparatus were described by the writer in an article entitled "Standard Shapes for Cutting Tools," which appeared in the AMERICAN MACHINIST, Volume 30, Part 2, pages 652, 757 and 793. The instruction chart and implements are issued to the workman in advance of each operation.

TREATING PLANT

The treating department is equipped with oil furnaces, cooling screens, pyrometers and heat-timing devices.

As oil was the fuel selected for the treating furnaces, owing to gas not being available, it was necessary to secure an oil-furnace for the high-heat treatment, so designed and constructed as to be capable of generating and maintaining a heat beyond the melting point of high-speed steel. A series of heat tests with the various types of oil furnaces on the market found one meeting the requirements.

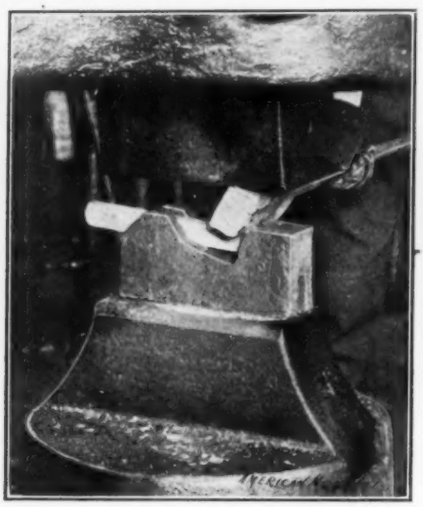


FIG. 6. TURNING UP THE POINT

As soon as it was realized that uniform results could not be obtained from judging by the appearance of a tool when it had remained long enough in the high-heat furnace, it became apparent that for a given-sized tool of a given kind, there must be a definite time for producing the required hardness and red-hardness in a high-heat furnace capable of maintaining the necessary uniform and intense heat, so that in order to secure the desired results, on a basis of time, temperature and mass, the use of instruments became necessary.

To obtain the best results high-speed steel should be preheated slowly to 1500 degrees Fahrenheit and then rapidly to a temperature just below the melting point. The heats in both preheating and high-heat furnaces are maintained at a uniform temperature, so that for each kind of tool of a given size, there will be a prescribed time in which the tool shall be subjected to the high heat in order that the desired qualities of hardness and red-hardness may be developed without injury to the steel.

The temperature of the preheating furnaces is regulated to 1500 degrees Fahrenheit and is continuously measured by a pyrometer of the Le Chatelier type coupled to a wall type indicator arranged to read direct in degrees Fahrenheit as shown in the upper left-hand corner of Fig. 11. This temperature remains constant by reason of the fact that the supply of oil and air can be regulated to give the desired heat; a condition which makes it impossible to heat tools beyond this point.

FIG. 7. TRIMMING. TESTING BENCH AT LEFT

FIG. 8. TESTING THE POINT

For regulating the temperature of the high-heat furnaces a Fery Thermo-electric telescope is used. This type of radiation pyrometer is capable of measuring the highest temperature attainable. The telescope as shown in the foreground of Fig. 9 is focused on the flame in center of combustion chamber and by means of a twin cable attached to the thermo-couple in the telescope is joined to a pyrometer galvanometer where the temperature is recorded in degrees Fahrenheit by a thread recorder making a continuous automatic record of the temperature in the furnace. The recorder is shown in the lower right-hand corner of Fig. 11.

Having described the appliances for regulating and measuring the temperatures of the furnaces, a description of an instrument for measuring and indicating periods of time in which tools shall remain in the high-heat furnaces, is next in order. Stop watches were first employed for timing the high-heat treatment but were found unsatisfactory, as it was almost impossible for one operator to handle a watch, tongs, prepare a tool for treatment and place a tool in the preheating furnace in the time required for treating an average tool. This necessitated an assistant to do the timing. Then hour-glasses, containing different quantities of sand, apportioned to complete a flow in a period of time corresponding to that required for treating a tool of a given size were next tried. The objections to this method were; after the operator had placed a tool in the furnace and simultaneously turned the glass, he then directed his energies toward the preparation of tools for subsequent treatment, and frequently forgot to watch the glass. From these experiences came the evolution of a horometer, an instrument capable of indicating periods of time from ¼ of a minute to 4¾ minutes, and so constructed that by adjustment any fractional period between the two extremes can be indicated. The device is commercially known as a heat timer and is shown in Fig. 12.

This instrument involves the well known mechanical principles applied to clocks and consists of a wheel which is actuated by a suspended weight; the velocity of the wheel being controlled by an escapement which in turn is regulated by a swinging pendulum. The device is started by pulling a cord and when

*Continued from page 434.

he prescribed time has elapsed, it automatically rings a gong and stops. This is accomplished by means of pins and a pawl; the former are fitted into holes drilled in the rim of the wheel and spaced equidistant, the latter controls the gong clapper and operates the latch which restricts the pendulum from swinging. As the wheel revolves the pins come in contact with the pawl and carry it to a point where it slips by the pin and causes the latch to fall, thus stopping the pendulum and simultaneously rings the gong. This device indicates periods of time ranging from 0.25 to 4.75 minutes, and any time between these limits can be obtained by inserting the requisite number of pins in the rim of the wheel and by adjusting the position of the pendulum's bob. The device must be adjusted to indicate the exact period of time required for treating each size tool. With this heat-timing device one operator will treat an average of about forty tools per hour, and secure absolutely uniform results.

Rapid cooling of high-speed tools from the high heat down to, or below, 1500 degrees Fahrenheit is accomplished under a blast of compressed air. The necessary appliances consist of a table whose top is formed by a wire screen, a jointed pipe bracket capable of swinging over the entire screen surface, and a diffusing nozzle capable of emitting a copious volume of air sufficient to dissipate the heat. This arrangement is shown at the extreme left of Fig. 9.

It will be noted that the tools on the screen, as shown in the photograph, are partly incased in a covering. This is to prevent the intense heat of the high-heat furnace directly affecting any portion of the tool other than the nose. This cover is an asbestos composition, made by mixing long asbestos fibers with water to about the consistency of putty, and can be used several times by re-mixing.

It will also be noted that a stand is shown in the photograph located in front of the furnaces. This stand contains a powdered slag into which the nose of a tool is dipped when it is transferred from the preheating to the high-heat furnace. This slag, under the effect of heat, forms a coating which prevents the intense heat from injuring the outer layers of the steel before it has penetrated the entire body of the nose.

Treating High-speed Steel

This high-heat treatment consists of:

a—Heating the tool slowly to 1500 degrees Fahrenheit.

b—Heating the tool rapidly from that temperature to just below the melting point.

c—Cooling the tool fast to below the breaking-down point, i.e., 1550 degrees Fahrenheit.

d—Cooling the tool either fast or slow from this point to the temperature of the air, and classified as follows:

1st. Preheating. 2d. High-heat. 3d, Cooling.

Preheating

Place a number of tools on the hearth of the preheating furnace with their noses at a slight distance from the fire until they have warmed up, when they are moved gradually toward the hotter portion of the furnace so that the entire nose of the tool may be slowly and uniformly preheated to a bright cherry red, allowing plenty of time so that the heat may penetrate thoroughly to the center of the nose and thus avoid danger of cracking from too rapid heating. As the tools are moved from the hearth, in the fire and away from the furnace, other tools should be placed on the hearth so that as long as the batch to be treated lasts, there will be no delay in the warming up and preheating.

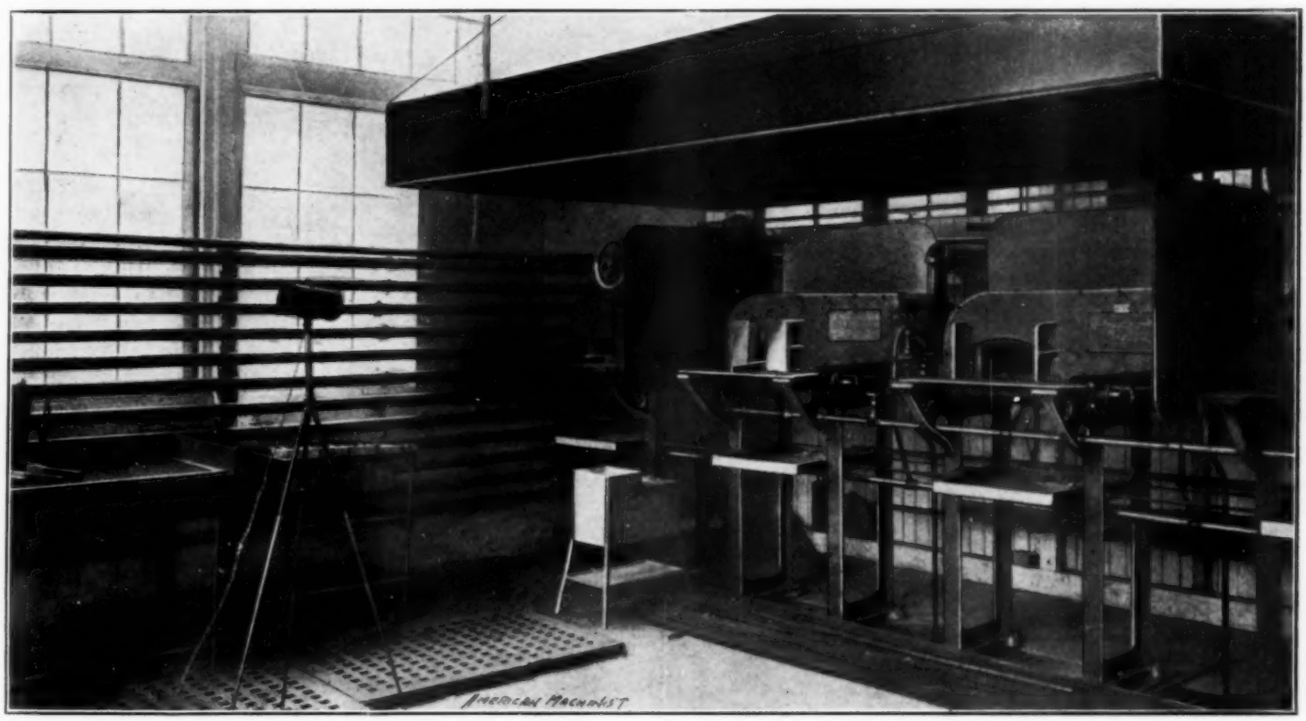


Fig. 9. General View of Heat-treating Department

High Heat

After the tool has reached its proper intensity in the preheating furnace, it is withdrawn, the nose dipped in the slag box and transferred to the high-heat furnace. This transfer must be made with rapidity so as not to allow the tool to cool to any marked degree. Simultaneously with placing the tool in the high-heat furnace, the operator with his free hand pulls the cord and starts the heat timer. The tool remains in the high-heat furnace until the gong sounds, when it is immediately transferred to the cooling screen. In the interim the operator gives his attention to arranging the tool at the preheating furnace and to the preparation of tools for treatment.

Cooling

Immediately the tool reaches the cooling screen its nose is placed directly under a heavy blast of compressed air and allowed to cool to below 1500 degrees or to the temperature of the air, before being removed from the blast.

Tools treated in this plant, with the equipment described, retain the fine velvety grain that characterizes the best high-speed steel, and are equally efficient for roughing or finishing either steel, brass or cast iron. While the tools treated at lower temperature (1800 to 2400 degrees) as is the more common practice, require a longer exposure in the forge or furnace, and as a consequence the desirable property of red-hardness is impaired, a coarse grain is developed and the outer layers of the steel are slightly injured. Any of which renders the tool unfit for finishing work and less efficient on roughing, owing to the particles that easily crumble away at the cutting edge, causing the tool to ruin more quickly.

Fig. 10. Tempering Furnace and Bath

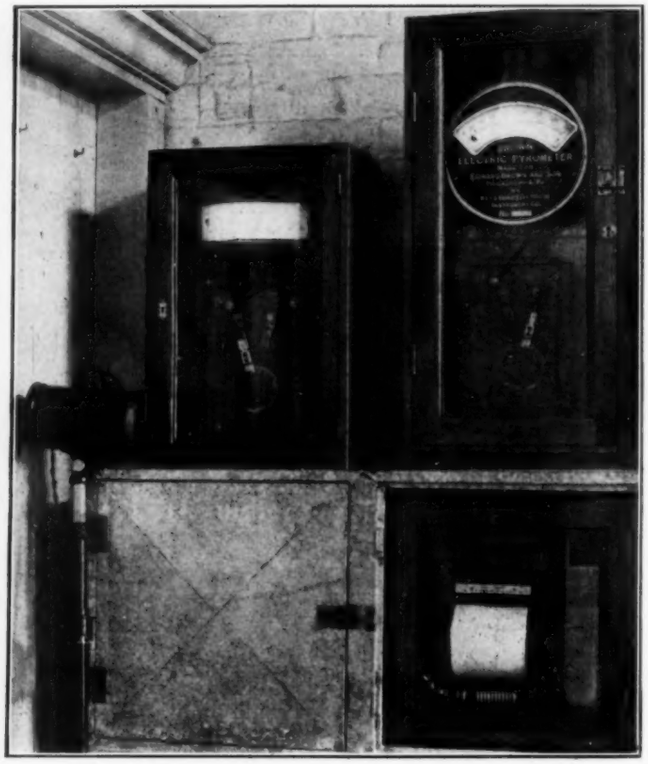


Fig. 11. Pyrometer Galvanometer for Furnaces

Grinding Department

In selecting grinding machines, not only for the central plant but for the yards as well, particular attention was given to the method of applying pressure to the tool during the operation of grinding. It being recognized that high-speed tools are easily injured by being overheated during the operation of grinding, even though a heavy stream of water is thrown continuously upon the nose during the grinding operation. The injury to tools from overheating in grinding is most serious because there is no way of detecting it except by finding through actual use that the tools are of inferior quality. The practice of fastening a tool rigidly in a slide or tool rest which is fed against the emery wheel with a screw (positive feed), is to be deplored, since, soon after grinding starts, the surface of the tool is made to conform exactly with the shape of the wheel, after which grinding becomes exceedingly slow and the tool is rapidly overheated. As soon as the tool's surface, which is being worked upon, is ground so as to fit exactly and closely against the outside surface of the wheel no water can find its way between the wheel and the tool and thus carry off the heat from the latter.

The uniform reproduction and maintenance of standard shapes for cutting edges, as adopted by the Board, was next given consideration. The best method presenting itself was grinding by means of formers made exactly to the shapes desired. Machines designed to grind tools in this manner were selected as they would insure uniform shapes in the initial grinding given at the central plant, and in the subsequent grinding given at the yards. The relation between the former and the tool's cutting edge is shown in Fig. 14.

Sample tool boards, illustrated in Fig. 15 displaying 41 shapes of standard lathe and planer tools, as adopted by the board and manufactured at the central plant, were furnished to each yard. It will be noted that each tool is identified by a symbol denoting its class, shape, shape of cutting edge, straight or bent, and hand. A neumonic system of symbols was adopted to facilitate rapid handling of tools at the central plant and yards. All requisitions on the central plant for tools bear the symbols which signify the size (determined by the width of shank) and the kind of tool wanted. All of the dies, gages, formers, instruction charts, etc.,

First Letter.	Second Letter.	Third Letter.	Fourth Letter.
Class.	Shape of Cutting Edge.	Subclassification of Second Letter. Shape of Nose.	Straight, Bent and Hand.
			Straight ..... A
			Straight ... right ..... B
			left C
Paring ..... P	Parting C	Sharp ..... S	Bent 30° to right ..... D
	Round ..... R	Blunt ..... B	left ..... E
From general classification	Square ..... S	Broad ..... W	Bent 45° to right ..... F
	Side ..... U	Beveled ..... A	left ..... G
	V-Shape V		Bent 60° to right ..... H
			left ..... J
			Bent 90° to right ..... K
			left L

KEY FOR SUBCLASSIFYING STANDARD SHAPE CUTTING TOOLS.

used in the manufacture of tools bear a symbol corresponding to the symbol shown on the sample board for each respective shape and size of tool.

The key for sub-classifying the shapes, together with the signification of the letters making up the symbols, are given in the following table.

Physical Tests

To carry out the tests, an extra heavy lathe, provided with special feeds and speeds, was installed in the central plant; as were test pieces, which are open-hearth steel forgings, 10 feet long and 20 inches diameter, whose physical characteristics are known.

In making physical tests the importance of performing the work on a lathe capable of pulling the desired cut without variation in the established speeds, is not generally recognized, nor is the material usually employed for test pieces of a known and uniform quality. Uniformity in cutting speed and in the quality of metal cut enables physical tests to be carried out with a degree of accuracy.

Chemical Tests

Drillings are taken from the test pieces furnished with the various lots of steel and are analyzed by the Government chemist. The tolerances (in per cent.) are given in of the Naval specifications. From time to time "check analyses" are made by other chemists. Test pieces drilled and tools ready for test are shown on the stand in Fig. 16.

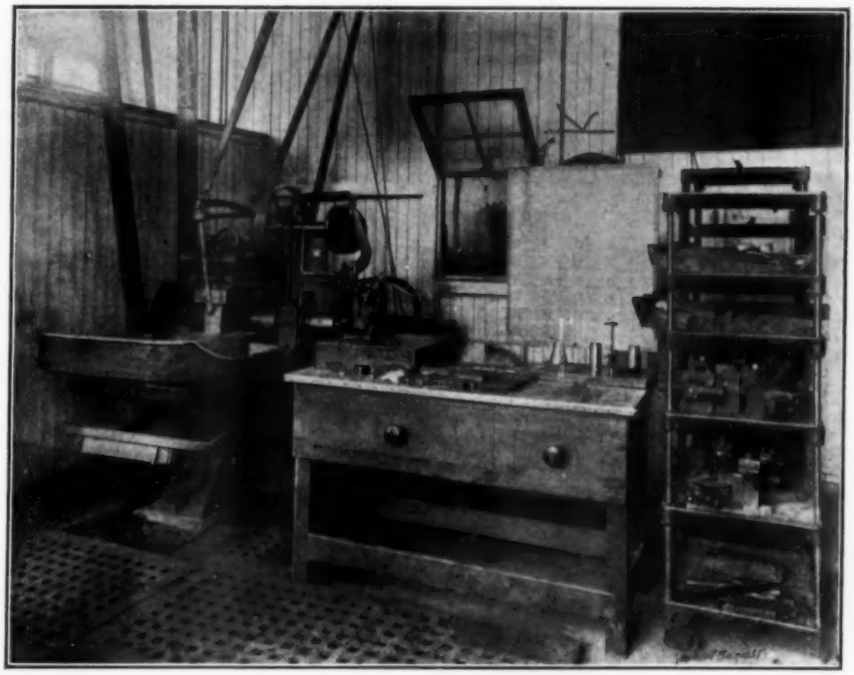


Fig. 13. The Grinding Department

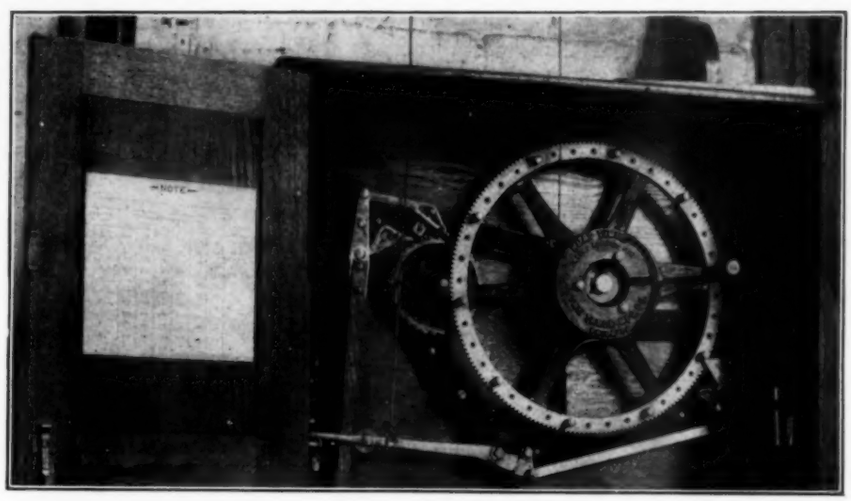


Fig. 12. Heat-timing Machine

General Outline of System

Standard tools will be regularly carried in stock by the general storekeeper, who will fill orders received from the various yards. Balance sheets, or stock ledgers will be kept in the planning department of the manufacturing department, showing, for each kind and size of tool, the quantities in stock, under way, required to fill orders on hand, and the balance available for future orders.

From time to time, in accordance with the demand (i.e., when the balance sheets show the quantity available for filling orders to have fallen to a minimum decided upon) manufacturing orders will be issued for making up a lot of tools. These will always call for as large a lot of any given size and kind of tool as is consistent with the demand.

Each yard will regrind standard tools furnished by the central tool-dressing plant until such time as they require re-dressing, when they will be returned and replaced by newly dressed tools furnished from stock by the general storekeeper. Worn-out tools when returned will be placed in bins in the tool-storage room, a separate bin being kept for each size and kind of tool, and whenever manufacturing order for tools is issued these will be included in the material for the order—thus, if 100 tools are called for on a manufacturing order and there are 50 of that kind and size of tool on hand to be re-dressed, they will be issued to the forge shop together with the material for 50 new tools. The new steel only being charged to the manufacturing order, and as no charge is made for the worn-out tools, the effect will be to decrease the average cost per tool to the yards ordering.. The general storekeeper will make no distinction between new tools and re-dressed tools. When a lot of tools are finished they will be delivered to the general storekeeper, with an invoice giving the cost of the same and the new average cost per piece at which they are to be charged when issued.

Tools for the Philadelphia yard will be re-ground in the central tool-dressing plant, the tool room each day making up a lot and sending them to be re-ground and returned. New tools, or tools to replace those requiring re-dressing, will be ordered from the general storekeeper. Re-grinding of tools for the Philadelphia yard will be charged to the proper standing job order.

Raw materials, that is steel in bars, and worn-out tools to be re-dressed, will be stored in bins provided for the purpose in the storage room attached to central tool-dressing plant. Finished tools will be delivered to the general storekeeper's department upon the completion of a manufacturing order. Worn-out tools that have become too short to be again re-dressed, will, when suitable

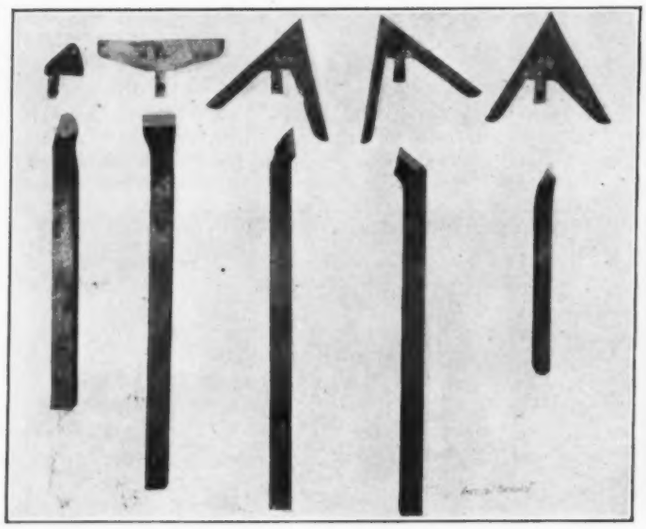


FIG. 14. THE FORMERS AND THE TOOLS THEY SHARPEN

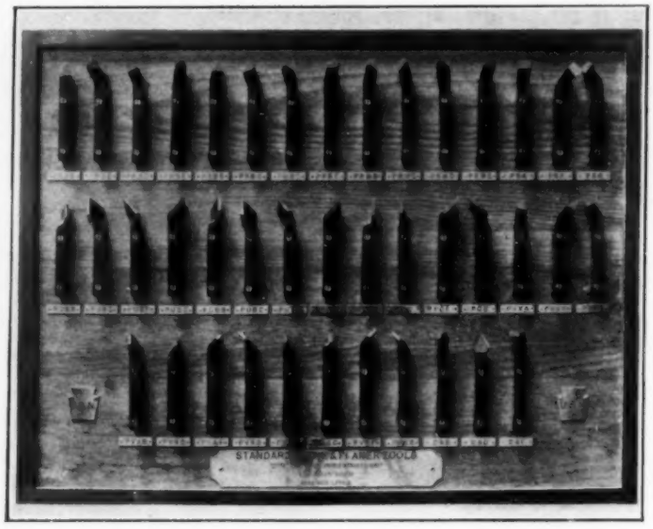


FIG. 15. SAMPLE TOOL BOARD

quantities accumulate, be drawn down to bars suitable for smaller size tools. Manufacturing orders will be issued in the regular manner for this work and when this steel is used in making tools up, it will be charged to the order for the tools for which it is used at the price it costs to draw it out. Drawing down short pieces of steel will give employment to the steam hammers when work on tools is slack.

RESULTS AND CONCLUSIONS

One of the main reasons leading up to the establishment lay in the fact, that, although the navy yards were supplied with expensive high-speed steel, the results were not commensurate with the price paid for the steel. This was very largely due to improper heat treatment. The proper treatment of high-speed steel is a very simple and easy undertaking if suitable apparatus is provided and it is reduced to a mechanical process.

Before the central plant was established, the different yards treated high-speed steel in oil-furnaces, and in soft-coal or coke forge fires with no degree of uniformity in the results obtained. This condition was due to the fact that no means were provided for determining as to whether the heats obtained were sufficiently intense, or whether the tools were exposed for the proper time, other than by the operator's judgment. In the case of oil-furnaces, the construction was, in most cases, such as to be incapable of withstanding the high heat after it had been once generated nor were these furnaces designed with a view of generating a heat more intense than is ordinarily required for forging. In the case of soft-coal or coke fires it was almost impossible to maintain in a forge of reasonable size, a uniform and intense heat for any length of time.

The principal advantages possessed by a central plant over each yard forging and treating its own tools are summarized as follows:

Saving effected through buying steel in larger lots according to standard chemical and physical specifications; permitting competition and resulting in getting a uniformly high-grade steel at a lower cost than where it is bought in small lots by proprietary brand.

Economy in operation due to making up tools in larger lots on a manufacturing basis, and to workmen becoming skilled in all branches of a particular class of work.

Maintenance of standards being far easier to accomplish in one plant than in several, and all plants are assured of uniformly high-grade tools.

Smaller outlay is required for equipment than if each yard does its own dressing and treating.

By confining all experiments and tests to one special department, production in the shops in the various yards is not interfered with and the officers and men in charge can give their entire attention to the efficient running of their shops.

It was found that, while the central plant was productive of great economy in the manufacture of uniform tools as compared with the previous method, there were also other elements of shop practice combined with the use of and maintenance of tools, which would effect large economies provided uniform methods were employed at all yards forming the

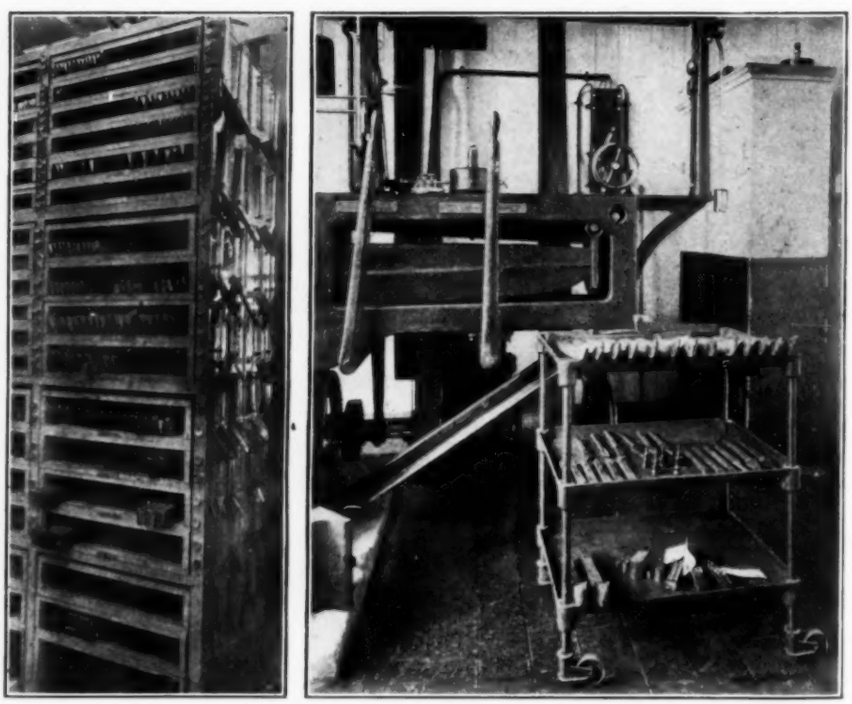


FIG. 16. MAKING PHYSICAL TESTS

group dependent upon the central plant for their supply of tools. To facilitate the maintenance of uniformity in the shape of the cutting edges of all tools, after their first use and until the time they require re-dressing, each yard in the group was equipped with a universal tool-grinding machine (a facsimile of those at the central plant) capable of reproducing the prescribed shapes by means of formers. The application of other economical methods to be employed in combination with the use and maintenance of tools was left to the officers in charge of the navy yard shops, and from observations made by the writer, while visiting the different yards, found the officers in charge thoroughly conversant with the requirements of their respective shops, in this connection, and were augmenting the value of the central plant by applying those elements of shop practice so closely connected with the use and maintenance of cutting tools.

In order to secure the greatest output from a machine shop, two things are manifestly important: The machine-tools must be run at high speeds and they must be kept running as nearly continuous as possible.

In the first instance the desired result is largely accomplished by furnishing the operator with properly forged, treated and ground tools, which will permit of the machine running at high speeds. In the second instance by establishing a systematic method of grinding, so that an end is put to the practice of allowing machines to stand idle while the workmen grind their tools or await their turn at the grinder; by removing all grindstones and emery wheels generally found scattered throughout the shop, and thus compelling the workmen to procure their tools from the tool room through the medium of messengers, provided for the purpose of carrying tools between the machine operator and the tool room.

The advantages derived from grinding tools in a systematic manner are summarized as follows: Increased output due to machines not standing idle while workmen grind their tools; increased output due to tools being ground to uniform standard shapes; saving in the cost of grinding tools.

It was anticipated that high-speed steel in accordance with the specifications probably would be more expensive than the kinds previously purchased. This expected increase in price was to be offset by greater efficiency of tool steel and the more satisfactory conditions that would result from having a definite heat treatment. It was realized, further, that the question of net saving from the use of better quality tool steel would depend largely upon whether shop system and management were adapted to taking full advantage of the better and more uniform tool steel used.

Contrary to expectations, however, it was found that steel manufacturers bid extremely low prices on high-speed steel purchased under the specifications, several large contracts having been let at a price of 34 cents per pound as against prices previously paid for proprietary brands varying from 40 to 60 cents.

Carbon Tool Steels

While it is not intended in this article to treat in detail anything but the manufacture of high-speed lathe and planer tools, it is of interest to note that similar methods have been applied by the officers in charge of this plant, with most gratifying results, in the purchase of carbon steels and in the manufacture of carbon-steel chisels and flat drills for use in air tools, great quantities of which are used in ship work. The proper hardening and tempering temperatures being determined for each lot of steel in accordance with the requirements of the specifications under which the lot was purchased. This method of purchase and treatment has entirely overcome the trouble and expense experienced in the past with tools of this class. The tempering furnace and bath for carbon tools are shown in Fig. 10.

Power Loss of a Slipping Belt

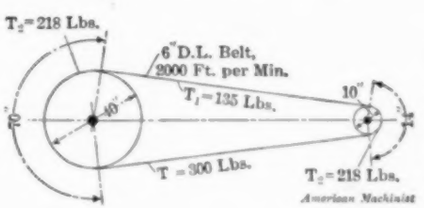
By A. L. Campbell

One often sees discussed the question whether or not a slipping belt is less economical of power than one which does not slip. If we consider that when a belt slips friction occurs between the pulley and belt, thus creating heat, it is at once seen that part of the driving power is "lost," as the radiation of this heat attains no useful end. The approximate amount of this loss may be obtained as follows:

A motor delivers ten horsepower to a line shaft by means of a six-inch double leather belt running 2000 feet per minute. The accompanying sketch shows the belt tension T to be 300 pounds on the tight side, while the tension T_1 on the slack side is 135 pounds. The average belt tension T_2 will then be about the half sum of the other two, or 218 pounds.

The tension in the walls of a thin cylinder due to a uniform pressure is equal to the product of the unit pressure multiplied by the radius of the cylinder. Conversely, since the average belt tension at the pulleys is 218 pounds, the average belt pressure per inch length of contact with either pulley is equal to 218 pounds divided by its radius in inches. This amounts to 11 pounds for the large pulley and 44 pounds for the small one. Since the lengths of belt contacts are 70 inches and 14 inches respectively, the total pressure of the belt on the large pulley is 770 pounds, and on the other 616 pounds.

If the total belt slip be 10 per cent. the slip on the motor pulley will be about 6 per cent., or inversely proportional to the total belt pressures. A 6



Tensions in the Belt

per cent. slip on the motor pulley amounts to 120 feet per minute. If the coefficient of friction of leather on iron is 0.2 then the grip of the belt on this pulley amounts to 616x0.2, or 123 pounds. The loss of work is then 123 pounds multiplied by 120 feet per minute or 14,760 foot pounds per minute. In like manner, the belt slip on the large pulley being 4 per cent., the pulley rim travels 80 feet per minute slower than the belt. The grip of the belt on this pulley is 154 pounds and the energy lost per minute is 12,320 foot pounds.

The total energy lost in this drive due to a 10 per cent. belt slip is then about 27,000 foot pounds per minute, or seven-eighths of a horsepower. In the above computations centrifugal force on the belt has been neglected.

It would thus appear that the proper remedy is to set belts so tightly that slippage will be reduced to a minimum. (Some slip is necessary, since without slip there is no friction between belt and pulley, and no power can be transmitted.) This, however, is apt to produce excessive strains in shafts, bearings and belts; and high repair bills will result. A much better solution would be to use some reliable belt dressing and run belts as slack as possible with little slip.

The principal points to be observed in mechanical tests of lubricants are the effects of speed, load, temperature, and the frictional effects due to viscosity and oiliness, according to a paper presented to the American Society of Mechanical Engineers. The measurements on which depend the quality of the oil include the frictional resistance, the temperatures, and the endurance of the oil film.

Making Copper Rolls for Printing Cloth *Editorial Correspondence*

The printing of designs or figures of any kind on cloth requires much careful preparation in the way of making the rolls from which the designs are printed. These are usually made of copper and vary in diameter from about 4 to 7 inches and in length up to 48 inches, with a bore of from 3 to 4 inches in diameter. The rolls are first turned off in a lathe which is usually made specially for this work and are finished by a grinding wheel shown in Fig. 1 where it is mounted on a vertical spindle. This does away with the use of hand polishing stones and not only grinds the roll but leaves it polished all ready for the engraving. It will be noted that the grinding spindle is spring-mounted, which is an unusual method in connection with grinding.

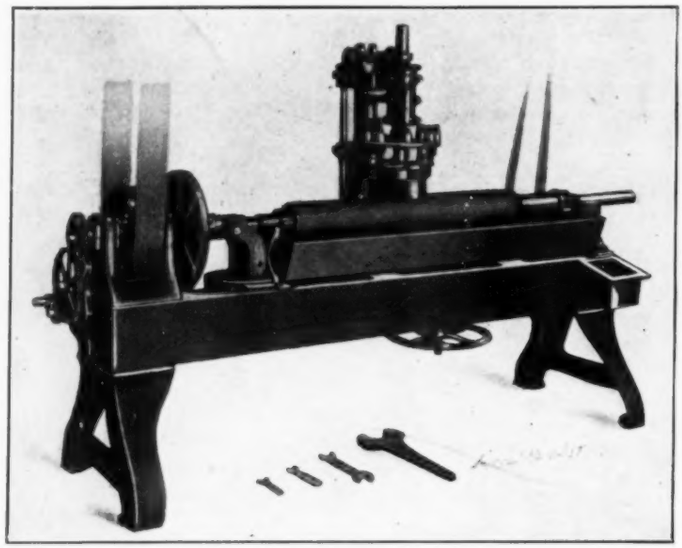


FIG. 1. GRINDING THE COPPER ROLLS

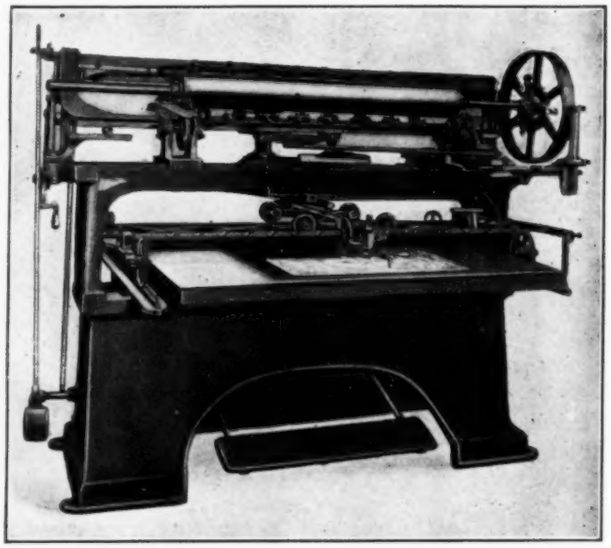


FIG. 2. ENGRAVING THE ROLLS

ENGRAVING THE ROLLS

After the roll has been accurately ground and polished, it is given a coating of asphaltum varnish and goes to the engraving machine shown in Fig. 2, to have the desired pattern cut through the varnish before being etched. The pattern is greatly enlarged and is usually made on a zinc plate which is placed on the bed as can be seen, so that its outline can be easily followed by the operator and a reduced copy engraved on the roll by each of the diamond points shown. These are usually worked on opposite sides of the rolls as shown in this case, so that, in this particular instance, 18 cuttings are being made at one time.

The roll has to be very carefully proportioned so as to distribute the design uniformly upon its surface, and is mounted so that it turns on the outside of the roll itself, instead of depending on the accuracy of an arbor. It is so arranged that any fore-and-aft movement of the tracing pointer turns the roll a proportionate amount and copies the design perfectly.

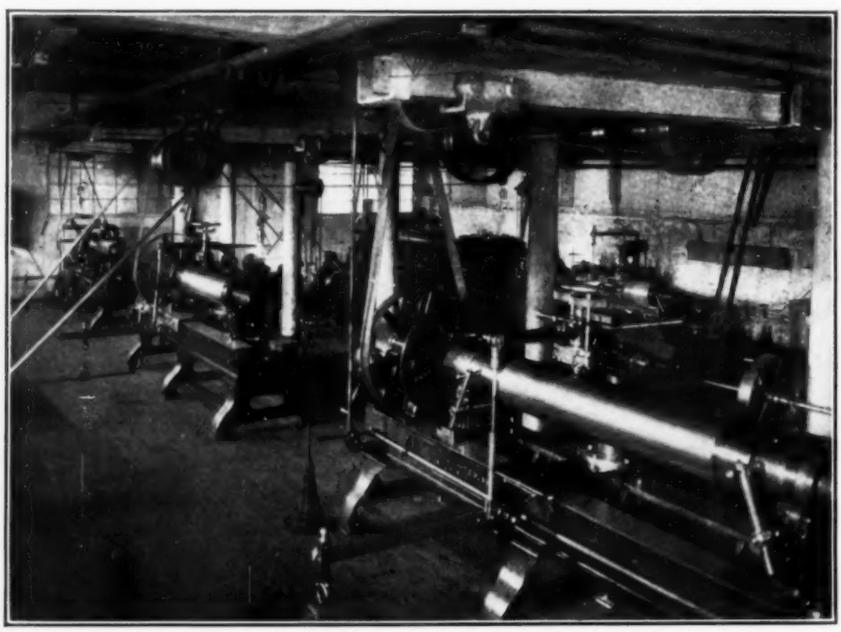


FIG. 3. A CORNER OF THE ROLL-MAKING SHOP

THE BACKGROUNDS

Backgrounds are usually made by what is known as the "pricking-on" process, which in effect is a nurling operation in which the nurl cuts through the coating of varnish in the same way as the engraving tool and allows the acid to attack the copper and produce the design. In pricking on this background the roll travels over the figure designs which have been already traced, so that it is necessary to go all over these designs and carefully varnish out the background where it interferes with the figures, in order to prevent any etching where it is not desired.

Fig. 3 shows a corner of the shop of John Hope & Sons, Providence, R. I., who make this machinery and do work of this kind. Four pricking-on machines are shown and vertical-spindle grinder is at work at the back of the room. It will be seen that the rolls run on their own journals as in the engraving machines. After this it becomes a simple etching operation, and with a few finishing touches the rolls are ready for use.

The Beverly Industrial School

Editorial Correspondence

The Independent Industrial School, of Beverly, Mass., opened in August, 1909, is an excellent example—which perhaps cannot be equaled—of what a small city can do for industrial education, and of a way in which manufacturing interests and school authorities can coöperate to mutual advantage in solving a troublesome educational problem.

A word of explanation in regard to the city and its industrial conditions is necessary. Beverly is a small city of some 17,000 inhabitants, situated on the coast about 20 miles north of Boston at the terminus of Boston & Maine suburban railway service in that direction. Within the city limits are a large number of country estates occupied during the summer by the colony that welcomed President Taft during the season of 1909. There is also a large farming community carrying on a dairying and market-gardening business. In manufacturing there are but two industries—the making of shoes and the making of shoe machinery. The latter is by far the more important, employing some 3000 men and occupying a new and thoroughly modern plant.

Beginning of the Movement for an Industrial School

During the winter seasons of 1907-1908 and 1908-1909 an industrial evening school was conducted in Beverly under the joint management of the school committee and the Massachusetts Commission for Industrial Education. No charge was made for tuition; textbooks were furnished free, and there were taught mechanical drawing, industrial drawing and design, shop mathematics and a few other allied subjects. The enrollment during the second winter was 275. This school was considered a success and was undoubtedly a benefit to men working at their trades during the day. At the same time it was realized that it did not reach the boy or girl just coming out of school, unfitted to earn a livelihood and yet compelled to go to work at once in order to obtain at least partial support.

Superintendent of Schools Adelbert L. Safford appreciated the need of specific trade education in the city and after conferring with the Massachusetts Commission on Industrial Education, and at their request suggested several representative men of the city as a local committee on industrial education. This suggestion brought action and the Beverly commission was appointed by the State commission, with George H. Vose chairman, representing the machinist trade, Mr. Safford, secretary, and seven other members representing shoe manufacturers, gardeners, organized labor, florists, business interests, the industrial evening school referred to above, and girls, the last through a woman member of the commission.

Work of the Beverly Commission

This local commission was appointed in October, 1908, and during that fall and the succeeding winter held frequent meetings. At these meetings representatives of the leading industries of the city were present and discussed the relations of their respective industries to industrial education. All agreed that something should be done. The representatives of the industries were a unit in stating that they were greatly in need of skilled workmen and would gladly assist the commission by employing the young people who had received industrial education as soon as they were fitted to enter the shops, or go out to the farms. No one, however, representing the agricultural interests or the shoe manufacturers, was willing to make any move to aid the commission in developing a plan for teaching the mechanical skill of their trades.

In dropping this phase of the subject it should be stated that the commission is still organized and hopes to develop a workable scheme to cover these two industries. In this article we are more particularly interested with the school that has already been started and which is teaching the machinist trade.

Apprenticeship and Trade School versus Industrial School

The opinion of this commission in regard to the disadvantages of apprenticeship and trade schools, when compared with an industrial school affiliated with a first-class factory, is so clearly written and of such interest that I quote it entire:

"The opinion of the Beverly Commission is that the schools in which the pupils are indentured under a forfeit to stay four years are hampered in various ways by this system and that on the whole, these schools are less favorable to the apprentices than to the manufacturers. On the other hand, the pupils that are merely taken into the shops on half time do not seem to receive that systematic and progressive advancement in learning the different parts of the industry that is desirable. The money value of the product of the boy's labor often seems to be more determinative to the manufacturer than the pupil's progress in learning the trade. To a certain extent, the pupils are exploited in this way for the benefit of the manufacturer.

"On the other hand, in a mere trade school where the work is not carried on under the conditions of a real factory, it is almost impossible for the pupil to attain a practical skill and efficiency equal to that of a good workman in a factory. The workman's time as a factor in the cost of production, never can be sufficiently demonstrated to a pupil in a mere school where his presence and wages do not depend upon his actual productive ability. Neither can the time that may properly be used and the skill required for the different operations be sufficiently understood by the pupil until the product is put to actual commercial use and the pupil rewarded for his work in proportion to his perception and adjustment of these factors of production. Moreover, the establishment of independent factory schools involves a very large expenditure for buildings and equipment and a large cost for maintenance and raw materials. This cost is reduced by the sale of products, but the school is at a serious disadvantage both in the purchasing of raw materials and in the marketing of products. Moreover, an independent factory school must establish and maintain its own standards of efficiency in workmanship and production, and its own *esprit de corps* among its workmen and its own standards of scholarship and equipment in its school, while the industrial school that is affiliated with a first-class factory on the one hand and a first-class school on the other, without being dominated by either factory or school, has constantly before its pupils the best standards, both industrial and educational, which must be powerful incentives to the pupils of the school."

The scheme and organization of the school as established is consistent with the above opinion.

Proposal of the United Shoe Machinery Company

After a large number of meetings on the part of the commission, and agreement among its members as to what should be done, it still seemed as if the results would be negative, because of lack of coöperation on the part of manufacturers. However, the situation was entirely changed as regards the machinist trade by a proposal received from the United Shoe Machinery Company through its general superintendent M. B. Kaven. This proposal was: "A separate department will be organized in the factory of the United Shoe Machinery Company and equipped with all necessary machine tools for the accommodation of 25 boys at one time. Two groups of 25 will alternate between the factory and the school house. The company will furnish all material and keep the accounts as proposed, and purchase the products at established prices. The

United Shoe Machinery Company will make up the deficit between the earnings of the factory shop as shown by the account described above, and the cost of maintenance of the factory shop including the salary of the instructors while in the shop. The hiring of the shop instructor or foreman and manager of the shop will be in the hands of the Committee on Industrial Education as proposed above."

This proposal was accepted by the local commission, a favorable report made to the State commission and a suitable ordinance passed by the city government.

The management and control of the school is vested in a board of trustees, composed of the mayor, five members of the school committee and one or more citizens appointed by the mayor. It is provided that each proprietor of an industry who provides shop facilities satisfactory to the trustees shall be represented by one member of the board, nominated by the proprietor of the industry and appointed by the mayor.

Opening of the School

The school opened on August 2, 1909, with 50 boys enrolled, divided into two classes of 25 each. One class reported to the shop for a week's work, the other to the school room for a week's instruction; at the end of the week, the classes changed places.

School-room facilities are provided in the high-school building and include the use of regular high-school equipment for teaching drawing, blueprinting, physics, chemistry, business forms and methods, and the like.

The shop equipment consists of 34 machine tools of standard sizes and of the best makes, together with a full equipment of small tools. In addition the boys have checks and can draw tools from the regular tool supply-rooms of the factory.

The relative cost of the equipments is worthy of note. On the one hand the city has set aside a small class-room with desks for 25 boys, representing a cost of perhaps a few hundred dollars. On the other hand the United Shoe Machinery Company has set aside a much larger amount of floor space and an equipment of machine tools and small tools representing an aggregate value of some $15,000 to $20,000. No one can say in regard to this proposition that the industry has not been ready and willing to assume its full share of the expense of industrial education.

Scheme of Instruction

In the school the boys are taught mechanical drawing, shop mathematics, fundamentals of physics and chemistry, English, business forms. But these courses have not been in operation long enough to be clearly defined. In connection with mechanical drawing, sketching is emphasized; clearly a most valuable point, for if there is any part of the art of drafting in which the average draftsman is deficient it is in rapid, intelligent, free-hand sketching.

The school day is of eight hours for five days a week. Saturday is given as a full holiday. No home lessons are required.

At the factory the aim is to teach skill in the trade under actual shop conditions. Thus regular machine parts are selected involving operations suitable for instruction and sent to the school shop department. Here they are given to the boys, together with the regular outfit of jigs, fixtures and other special tools, which would be used in a regular manufacturing department. No changes whatever are made from regular shop manufacturing conditions. The boy takes his job and may at first perform only one operation until he has mastered the use of the various tools. After that is done he takes his job and carries it through, operation after operation, until the part is finished. If a job is not finished during the week in which he is in the shop, as a rule it is laid aside until he comes again. In special cases, if the work is in a hurry, it may be finished by another boy in the school shop or sent to a manufacturing department. Each operation is inspected by a regular shop inspector under exactly the same conditions and with exactly the same care as if the work came from a manufacturing department.

Thus the shop atmosphere, shop hours, shop methods, shop accuracy and shop efficiency are all with a boy throughout his entire course in the shop school department. The length of the course is not definitely fixed at present, but will probably be from two to four years, depending upon the extent of the instruction that it is wise to give the boy.

As a matter of convenience Mr. Safford has taken up the active directing of the school work, and Mr. Vose of the shop work. Both are members of and responsible to the board of trustees.

Mr. Safford is now contemplating a revision of the work in the first six grades of the public schools, planned to lead up systematically to the work in the industrial school. Thus the latter will become a real continuation school.

The Pay of the Boys

All of the work furnished to the school shop department is piece-work and the boys are paid one-half of the regular piece-work rates; the other half is withheld as a partial reimbursement to the company for the expense of maintaining the department. On this basis the boys average while in the shop $2.50 to $3.50 per week in wages, the amount of the earnings depending almost entirely upon the energy and diligence of the boys.

It is probable that the school will never pay in a dollars and cents way, although the accounts show a slight improvement month by month from the time the school was opened.

The Boys Admitted

A requirement has been established that a boy must have passed through the sixth grade of the public schools, or have had an equivalent amount of schooling before being allowed to enter the industrial school, and to have attained the age of at least 14 years. A canvass of one section gave this result: Two boys were from the tenth grade, five from the ninth, eight from the eighth, five from the seventh, two from the sixth, and two others from lower grades. The exceptions were made on behalf of two boys of foreign parents, who had apparently received an amount of education equivalent to the sixth grade, but were handicapped because of their imperfect knowledge of the English language.

Some 12 or 15 of the boys in the classes are sons of men working in the factory. This speaks well for the attitude of the machinists of the city toward the school. If they did not believe that the instruction was adequate, both as regards the school work and the shop work, it is evident that they would not allow their sons to take the course.

Some five or six boys started the course in the summer and then dropped out to enter the high school. If these boys started the industrial course as an experiment, the fact that they returned to the high school probably proves nothing, but if the industrial school inspired them to get a better education, clearly it has already done a great deal for that particular half dozen boys.

Several boys have been dropped or discharged from the classes during the past few months. The final test is aptitude and diligence in shop work. If a boy shows lack of proficiency in school room, but diligence and skill in the shop, he need not fear losing his position in his class, for it is clearly recognized by everyone connected with the school that its aim is to produce skilled workmen.

When the school opened there were more than enough applicants to fill the two classes of 25 each. Since that time there has been a waiting list, having some 15 to 20 *bona fide* applicants. Thus it is evident that there is no difficulty in getting boys to attend the school and learn the trade.

Several boys who were working in regular shop departments have given up their positions there in order to enter the school, thus showing that they or their parents appreciate the difference in the quality of training, whether given through the medium of the school or whether picked up in manufacturing departments.

The Instructors

There are two instructors, one for each

class, and each instructor stays with his class, alternating between the shop and the school room. This feature is apparently an innovation. The instructor knows what work each boy has done in the shop and is able to adapt the school-room instruction to it, to explain and fix the principles upon which the shop work was based. At the same time he has no chance to become merely a teacher and grow away from the shop; or merely a shop instructor and grow away from the school or class-room view-point. The arrangement appears to be most happy, both for the good of the boys and the good of the instructors themselves. In addition to this teaching by the two regular instructors special instruction is given by the high-school teachers.

One-half of the salaries of the instructors is paid by the company.

The future must show us just what results will be obtained and how the scheme will eventually work out. Yet the beginning as sketched in this article is deserving of study and commendation. There has been real coöperation between the school authorities and the manufacturer; there has been no heavy burden placed upon the tax-payers of the city; the school authorities have had no complex problems in trade teaching to face and solve; and the shop has not attempted to tack school training onto a manufacturing business. The boys get their school training where they always have received it—in the school; and again they get their shop training where they always have received it—in the shop. Many believe that the employer should train his own workmen at his own expense. Here he does that very thing as regards mechanical skill. The United Shoe Machinery Company is clearly deserving of credit for the broad manner in which they have taken up this problem of industrial education and aided in its solution in their city.

Card Index Method for the Technical Library

By John S. Watts

I have read innumerable articles upon different methods of keeping and indexing scrap books, technical cuttings, etc., but have not heard of any system which appears to me to so entirely cover the field as the one which I have developed.

The fault I find with the usual methods of filing away clippings, whether under a system of self indexing or not, is that the index to these clippings covers only the clippings, whereas the information required may not be in the clippings but may have been seen in some other book, and then one must try to remember where it was seen and hunt through the indexes of a various number of books, wasting considerable time, should the item wanted not be indexed under the same name used by oneself.

Ellipse.	Book.	Page.
Area, to find	Moles.	676
Area of segment	B-2	29
Laying out	B-2	29
Periphery, to find	Moles.	660
Transverse and conjugate dia.	Moles.	660

The above shows a typical card from my index. For instance, if I want to find the area of an ellipse, the index directs me to Molesworth's pocketbook, page 676; if I want the area of a segment of an ellipse I must turn to my binder No. 2 (B-2) page 29. The cards I keep in a cabinet with alphabetical guide cards, and as will be seen, no matter in what book or in what clipping the information is to be found, the index will direct straight to it.

When I began this index I was aware of the tendency we all have at first to gather up all kinds of useless matter in our enthusiasm, so adopted a rule only to index such subjects or items as I had occasion to hunt up in the course of my work. To carry this out, whenever I come against any point upon which I have to look up an authority, I make a note of it on a pad I keep in the card index cabinet and in my spare time I make sure of having the best information to be had on the point, and then index the position of the information. If it is in one of my own books that finishes it, if it is in a magazine, catalog or such that I do not want to keep the whole thing I cut out the item and file it away in a binder.

I use two sizes of binders, both being plain spring-back loose-leaf binders, number them B-1, B-2 and number the pages consecutively as I put them in. Occasionally it may be desirable to interpolate a page between two already numbered, say we want to keep some items together, and to do so would have to place a page between pages 19 and 20. I simply number the new page 19.1 or 19.9, according to which page, 19 or 20, I want the new one to come next to. This can be carried on indefinitely, for one can put a page between 19.9 and 20 by numbering it 19.95.

It is not at all necessary to have items relating to similar subjects together, as the sample card will show, in fact if some items are in bound books and some in clippings it cannot be done without destroying the bound books, but is sometimes an advantage. I have been using this system for five years and have a practically complete index to all the information I am likely to want in my collection of technical books, although, of course, the clippings continually grow. I find it a great advantage to have only the one index to all my "five feet of books" and to know just what name to look for in the index, as one can when doing the christening himself, using names that habit has made familiar.

I use binders 6x9 and 9x12 inches and I have always been able to cut my clippings to one or the other of these sizes. There being no need to paste the clipping on anything, both sides of the page are available. If desired, it is just as easy to keep the whole magazine intact, and index the item as being in AMERICAN MACHINIST, Volume 10, 276.

A good feature of this system is that when one has got a method or formula indexed in this way, he will infallibly use the same again the next time a reason for its use occurs, as the fact of its being on the index proves its having been used before, and if it had not proved trustworthy it would have been removed. Without some such system one may use a different method every time to produce the same result and have the trouble of hunting it up and then use a personally untried formula.

Another good point of this method is that by always keeping a query on my pad until I find the information required, and by using my spare time hunting through all the available sources likely to give the answer I find to be a good education in itself, tending to keep me up to date.

The Truthful Business Broker

"When I bought this shop through you eight months ago you said it was a little gold mine, that the owner was selling out only on account of sickness, and that if I would give you a paltry three thousand for it I would not sell it six months later for ten thousand. As a matter of fact I can't get fifteen dollars a week out of the business, the late owner is the healthiest man in town, and no one but a fool would give me five hundred for the scrap heap you foisted on me for six times that amount."

"My dear sir, you wrong me. My business has been built on a foundation of truth and not only do I stick to truth but I at all times avoid exaggeration. I told you the shop was a *little* gold mine; I might have said a *microscopic* gold mine, but it would have savored of the braggart. I told you the late owner was sick; had you asked me the nature of his sickness, I would have told you he was sick of the shop. I said you would not sell the shop, six months after you bought it, for ten thousand dollars; I might have said you will never be able to sell the shop for half what I asked you for it, but as I said before modesty and lack of braggadocio are my long suits.

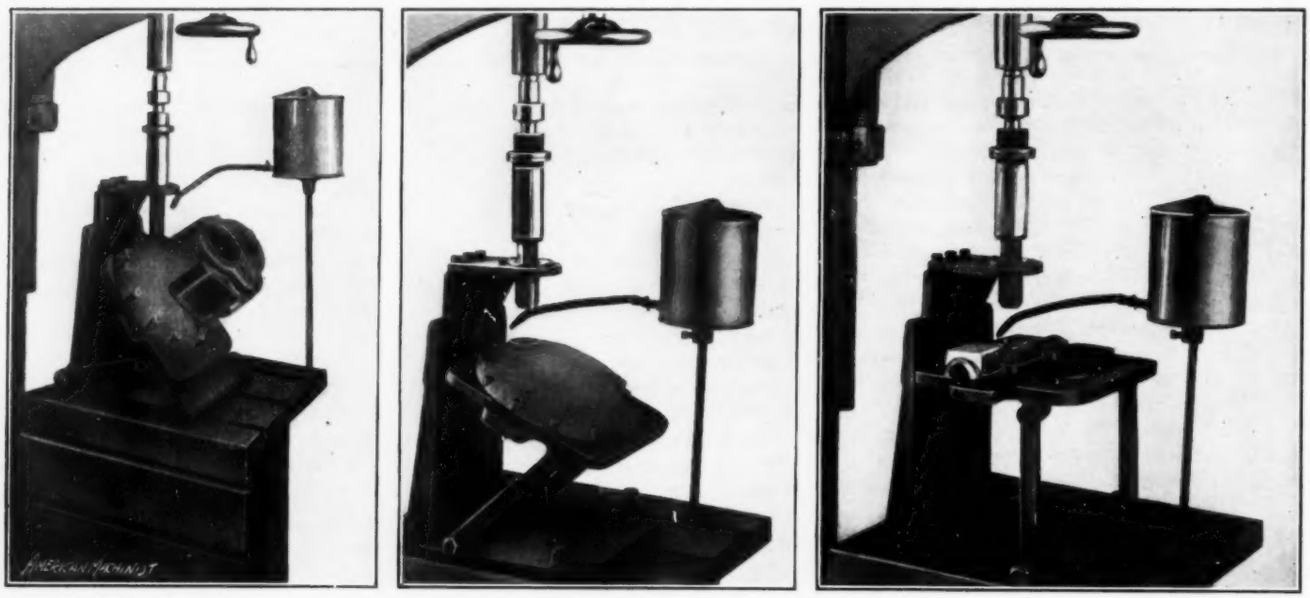
Drilling, Grinding and Milling Fixtures in Automobile Work

Convenient Methods of Machining Parts Quickly; Accurately

Editorial Correspondence

The drilling, milling and grinding fixtures illustrated herewith are from the shops of Nordyke & Marmon, Indianapolis, Ind., to whom we are indebted for the photographs.

A very convenient universal fixture for drilling, tapping and facing ball housing covers, rear-axle housing covers and transmission cases is shown in Figs. 1, 2 and 3. The fixture is quickly changed to suit the angle at which the piece must lie. The tap follows the drill and when through it is automatically released and drops through. The facing tool then finishes the job. This gives three operations with one movement of the drill spindle.



FIGS. 1, 2 AND 3. THREE USES OF A CONVENIENT, ADJUSTABLE ANGLE PLATE

Fig. 4 shows an indexing fixture for facing and boring bodies for the spur-gear oil pump. It is attached to the faceplate of a standard engine lathe, and is used in combination with a special turret tool post. The piece is slipped in against locating pins and is quickly secured with four hinged studs. When facing, the index pin is in the center. With the clamp loosened and index pin moved to one of two holes, one of the gear chambers is bored. The index pin is then moved to the third hole and the other gear chamber bored, bringing the centers the exact distance apart. A hinged stop is used on rear of cross-slide guide on carriage for limiting the diameter of the bore and for providing sufficient movement of the turret for facing.

A number of interesting fixtures are shown in Fig. 5. The upper groups are used for the gear-carrying plates in the rear-axle system and the lower for the transmission pieces. No. 1 is a jig for drilling the outside holes for securing the piece to the axle housing. No. 2 is for drilling the bearing cap holes. No. 3 handles the bearing bolt holes, while No. 4 is a boring fixture and cutter for a horizontal boring machine and takes care of boring the bearing support of the carrier plate for the differential gear. No. 5, fixture for turning the outside diameter and facing the bearing cap. No. 6 is another lathe fixture for facing the bearing caps on the inside, while No. 7 is an indexing fixture for boring the center holes for the gear.

Nos. 8 to 14 show the jigs and fixtures for the transmission cases. The first, No. 8, is a box jig used under a multiple-drill press for the bolt holes for holding the transmission case to the axle housing. No. 9 is an indexing fixture for locating the gear center holes, both for boring and facing. No. 10 is a drill jig, and is shown lying against the base of No. 9. This is for the holes for the

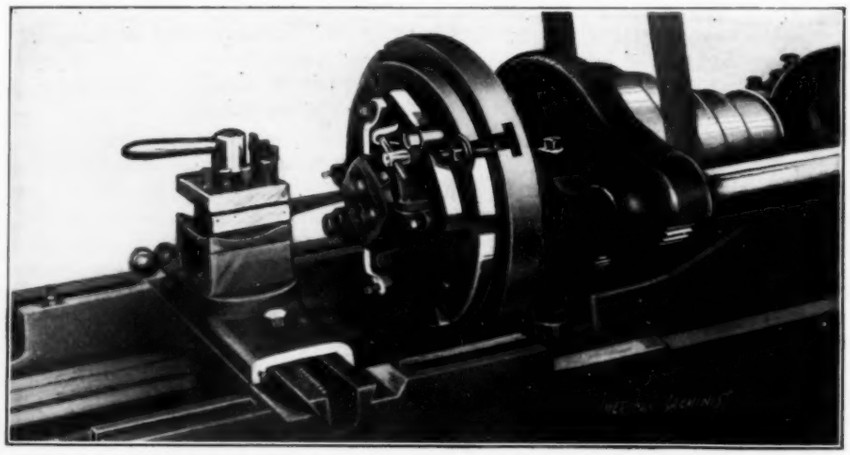


FIG. 4. INDEXING FIXTURE FOR OIL PUMP BODY

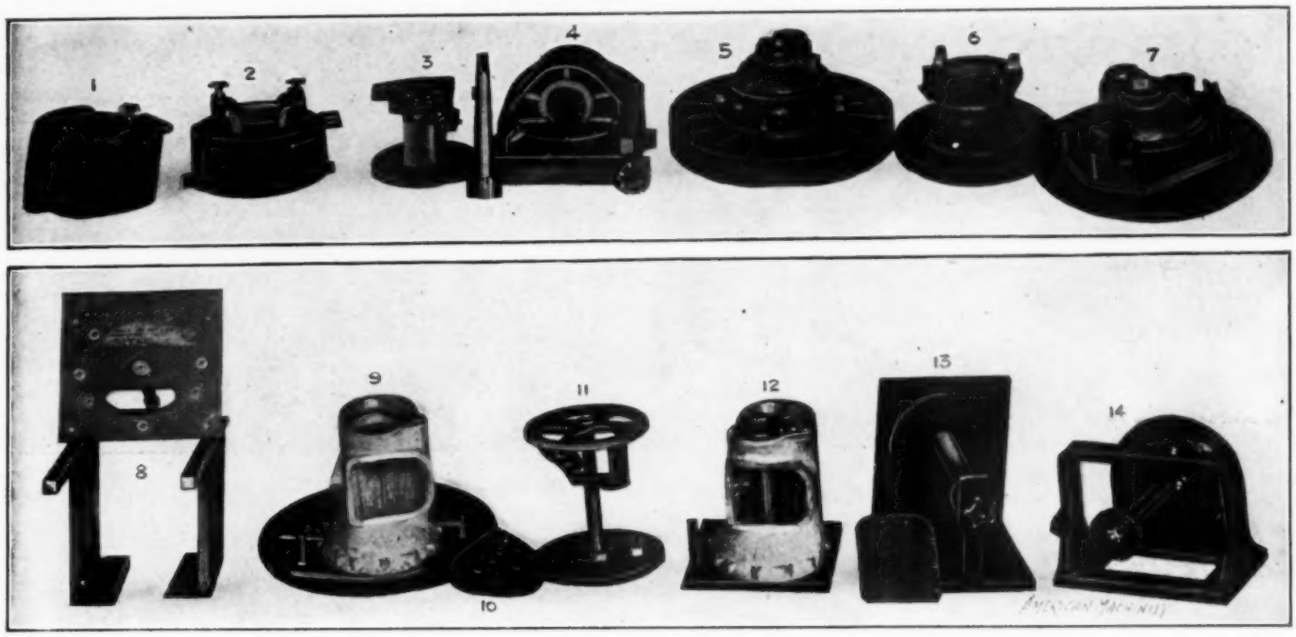


FIG. 5. A GROUP OF DRILLING, BORING AND FACING JIGS

torsion-tube support and gear-shifting bars. No. 11 drills the holes in the reverse shaft. No. 12 is a fixture for the horizontal boring machine for facing the cover joints at the side of the case. Fig. 13 is a combination jig which locates the holes for the cover plate, while No. 14 is for drilling holes in the side of the case for the screw which holds the reversing shaft.

Fig. 6 shows an indexing grinding fixture used for grinding square shafts. It is shown on a Brown & Sharpe No. 3 grinder having an ordinary spring collet in the spindle nose which grips the shaft on the round ends. The original pulley has been replaced with an indexing pulley to avoid the necessity of changing when the fixture is used for grinding round shafts.

In Fig. 7 is a very novel milling fixture which required no little thought and ingenuity to work out. It is an indexing milling fixture used for facing the aluminum oil-pump carrier, one of the faces being at right angles to the other. The fixture carries a gage pin for setting the fixture to the cutter for distance. The fixture is machined to receive the squared end of the piece which is clamped in

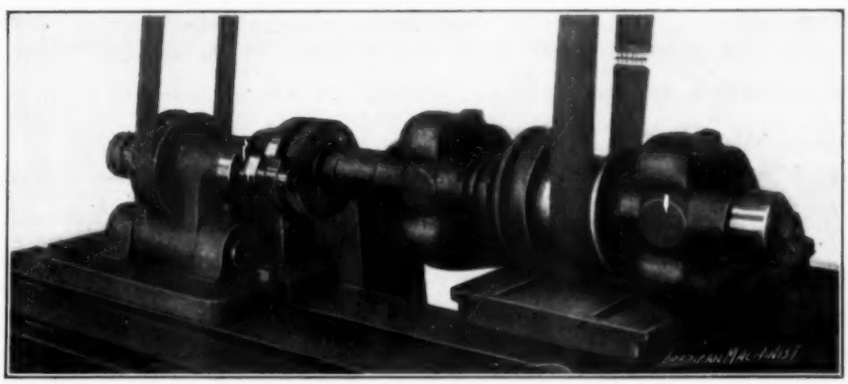


FIG. 8. GRINDING CAMS AFTER HARDENING

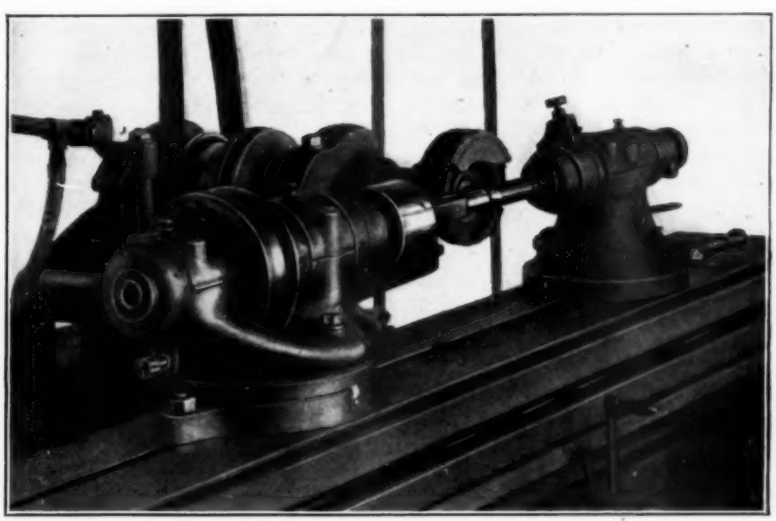


FIG. 6. GRINDING SQUARE SHAFTS

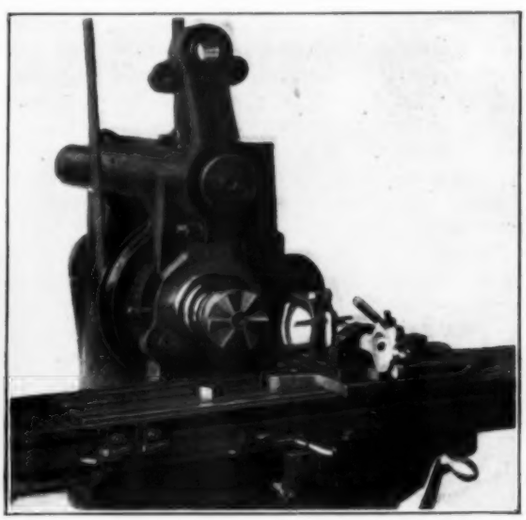


FIG. 7. A NEAT MILLING FIXTURE

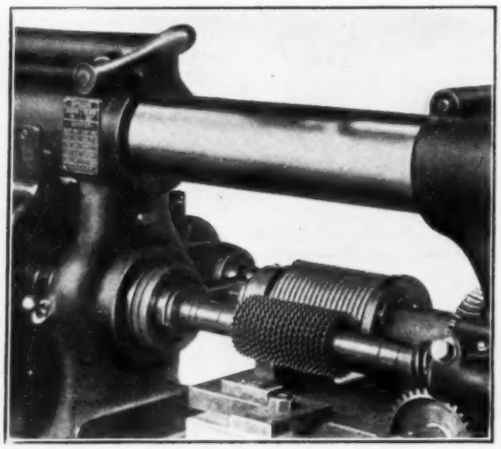


FIG. 9. CUTTING-OFF PISTON RINGS

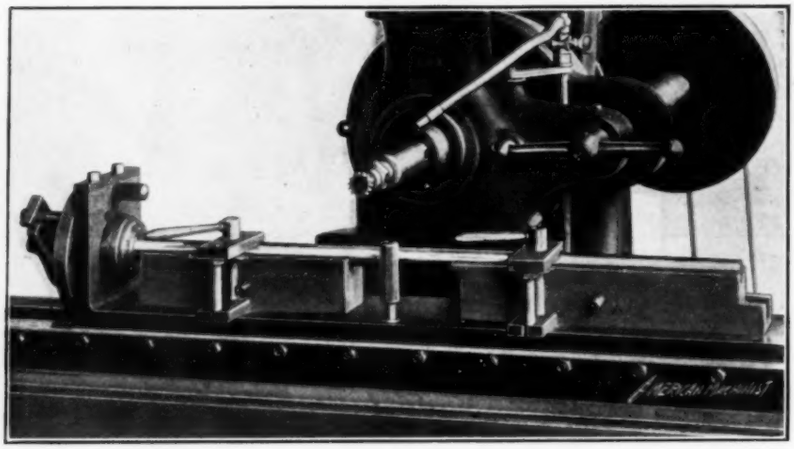


FIG. 10. MILLING KEYWAYS IN CAM SHAFTS

position and the other end is clamped in a V-rest, thus bringing the piece in exact position for the operations.

When the base is faced off in the position as shown, the fixture is indexed for the other end, bringing the right-angle surface to the cutter, making it unnecessary to move the table after the fixture is once set.

Cams are ground on a No. 3 Brown & Sharpe grinder with special fixture, as shown in Fig. 8. A base plate carries a hinged support for the spindle and a weight, not shown, which holds the master cam up to the roller on the wheel spindle. The grinding wheel is the same size as the roller referred to. The cam to be ground is fitted to the spindle in the hinged fixture alongside the master cam. With this fixture the grinding is done very rapidly and accurately.

An interesting milling fixture for cutting piston rings is illustrated in Fig. 9. A piston-ring pot is first bored and turned to size. It is then fitted on an expanding arbor which fits into the milling fixture. The arbor is revolved slowly by means of a double set of worm gears driven from the worm on the cutter arbor. A series of slitting saws properly spaced forms the cutter and the work is done completely at one operation.

Keyways are milled in the cam shafts by an indexing fixture illustrated in Fig. 10. The flanged end of the cam shaft is first drilled with four holes, and all keyways are located in certain relation with these holes. The fixture slides endwise on its base, having a locating pin to secure the various positions for the keyways in the length of the shaft. The index at the flanged end revolves the shaft for locating the keyways around it, making a very simple and efficient fixture for this work.

Foresight vs. Hindsight in a New Shop

By P. S. Locke

A visit to a machine shop in a small city of one of the middle western States brought out some interesting conditions, often found though generally less glaring.

The company was started by two brothers who owned practically all the stock. The elder, being more experienced and having developed some good ideas for oil-pumping machinery, took the management. The younger was made treasurer, but continued in a newspaper business until the concern should become large enough to warrant his becoming actively associated in its management. About the time the business had developed to this point the elder brother died and the treasurer assumed the management at once.

With a good organization trained by his brother, and being mechanically inclined himself, he was enabled to grasp the details with comparative ease; success followed the business and within a couple of years it became necessary to increase the manufacturing facilities and add a few machines to make their line more complete.

A customer was found for their land and building, a larger site was secured and a modern factory building, designed by a mill architect, erected. This building comprised three stories, a main floor and two galleries, with a traveling crane, and the scheme arranged for individual motor driven machines.

SELECTING A SUPERINTENDENT

The manager, though a hustler, finding the details of the shop too burdensome, selected a former associate in the newspaper office, who had put in some money when the capital was increased, to carry out these improvements and made him superintendent. Illness of the manager at the time they moved their old machinery and installed the new left the laying out of the shop to the superintendent.

HOW HE DID IT

Viewed from the end of the first gallery, and looking down the length of the shop, as I was being shown through by one of the young men from the drawing room, on account of the manager having an important meeting on hand, the general appearance impressed me very favorably; white walls, plenty of windows giving good light and an air of attention to business were the noticeable features. After a moment or so another feature became prominent that at first had not been noticed; there seemed to be an excessive number of trucks and boys weaving their way around and among the different machines. Keeping this in mind the cause revealed itself during our progress through the shop, and a few questions put to my guide further enlightened me.

WHY HE DID IT

The superintendent, not realizing the advantage of placing machinery to suit the work had arranged things according to his own ideas, somewhat after the plan he might have followed in "making-up" news in a paper; so much space to be filled—put the biggest machines in the most prominent places, like head lines and "scoops," and then group the other different kinds together as one might group "local news," "sporting events," "society gossip" or articles for the "woman's page." As an example of his method, the storeroom for small tools, supplies and parts that were made in quantity by automatics, etc., being regarded as nonproducing and a necessary evil, was placed at the extreme end of the right-hand top gallery in accordance with his idea of its value. A small ele-

vator had been put in, after the building was finished, to save time in getting to and from it. This elevator was referred to with much pride as an evidence of how uptodate they were in providing everything necessary to carry on the work.

The Effect

Following the work through was quite a puzzle. Castings came in at the receiving door, main floor left-hand side near the corner, were taken to the space in the center where they were cleaned and laid out for machining, then to the boring mills, main floor left-hand side south—to the planers, main floor left-hand side north—to the lathes, main floor right-hand side—to the drill presses, first gallery right-hand side—to the grinders, main floor left-hand side center—to the painting department, top gallery left-hand side—to the erecting department, main floor center. The small machines had to be taken from the erecting back to the painting department, while for large ones the painter had to come down to the shipping floor. The automatics were placed with the lathes, main floor right-hand side. Their material was brought from the stock-racks just outside the building on the left-hand side and taken when finished, to the storeroom with its elevator attachment, top gallery.

From the foregoing it is easy to see why so many trucks, boxes and boys were required.

The Result

On rejoining the manager in the office his manner indicated that approval of the plant as a whole was looked for. Relying upon my long acquaintance with him I spoke my piece, saying: "Building is fine but arrangement of machinery awful." He sat right up and with a belligerent air began to fire questions at me, the answers to which can readily be imagined. He was not fully convinced until a plan giving the location of machinery had been made with red-ink tracings—a startling cobweb effect, showing the progress of the work through the shop. Then a floor plan was drawn and cardboard blocks in various colors (denoting each machine drawn to scale), located thereon, showing a rearrangement which appeared practically to eliminate the costly criss-cross procedure.

The necessary changes were immediately started notwithstanding it was realized the cost would be several thousand dollars, to say nothing of interruption to the business, and in spite of the fact that much more had been spent at first than calculated.

Conditions of this kind prevail in a great many shops and are most always due to growth, to adding one machine at a time, to changes in the line of machines manufactured, to cramped quarters, to other things beyond the power of man to foresee. Rearrangement, especially where shafting is in use, is difficult and expensive. Study of this subject is often neglected, due to press of other, seemingly, more important matters.

By making sure that the cost of production is down to the smallest figures consistent with the standard of quality adopted and being ready to meet keener competition when trade slackens up and reductions in prices are made, "to keep shops running, to retain skilled help," etc., the concern that watches every little detail, stopping every possible waste, whether of time or material, proves itself fit for survival and succeeds in the long run.

Universal Joint Angular Variations

By E. J. Stoddard

The continually widening field for the application of machinery adds interest to each machine part and demands a closer study of its design. The automobile has greatly extended the use of the universal joint, and aviation promises to present still further requirements. The following is an attempt to make more accessible the data which may guide the judgment of the designer.

It is assumed that the design of joint is such that the pivots are at right angles to each other but the position of the plane through these pivots of attachment varies between the planes in which the ends of the shafts rotate. Let us represent the path of rotation of a pivot *x* on the driving shaft, by a circle in the plane of the drawing (Figs. 3, 4 and 5) and the path in which the connected pivot *y*, on the driven shaft rotates, by a circle of the same diameter as the first-named circle, and intersecting it. The path of the driven pivot is shown in full lines in front of the plane of the drawing and dotted back of said plane. These pivots are connected by a quadrant-link *x y*.

The positions of *x* and *y*, Fig. 3, are the data points from which the angles of

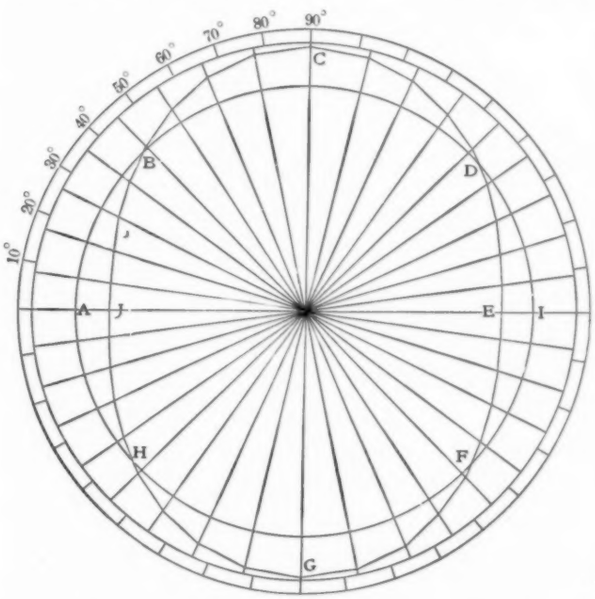


Fig. 1. Diagram Showing Relative Speeds and Positions of Two Elements of Universal Joint

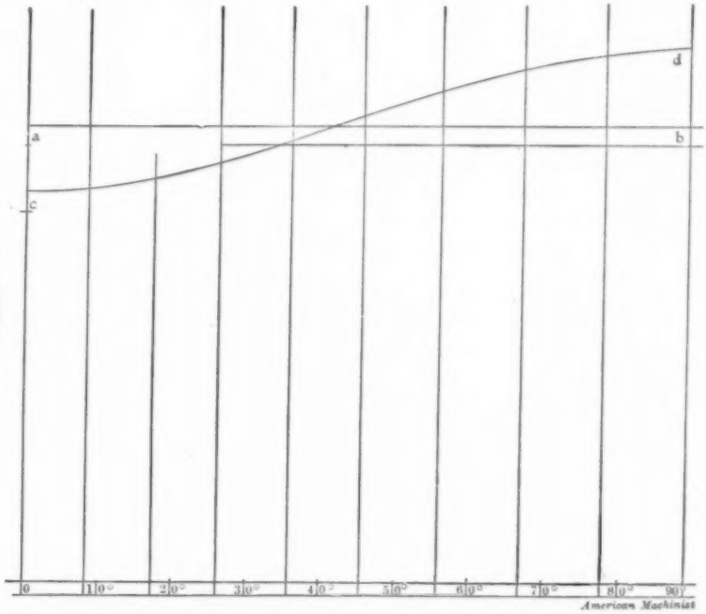


Fig. 2. Relative Speeds, Positions and Maximum Acceleration

the driving and driven shafts, respectively, are reckoned. In the position indicated in Fig. 3 the velocity of the driven point y is being retarded by the increasing angularity of the link $x\,y$ with reference to the plane of the path of this point and the velocity of the point y is a minimum. In Fig. 4, x and y have rotated approximately 45 degrees, the angularity of the link $x\,y$ is neither increasing nor diminishing and the velocities of the driving and driven shafts are equal. In Fig. 5 the angularity of the link $x\,y$ is diminishing with reference to the path of the point y and the velocity of the driven shaft is a maximum.

If we assume that the driving shaft has a uniform angular velocity, that of the driven shaft will vary in this same way but to different extents for different angles ø between the shafts. In Fig. 1 an angle, ø = 31 degrees, is assumed; the uniform angular velocity of the driver is represented by the radius of the circle $A\,B\,D\,I\,F\,H$, and the varying velocity of the driven shaft by the radii of the ellipse. The angle passed through at equal small intervals of time by the driving shaft is represented by the uniform divisions of the outer circles, and the corresponding positions of the driven shaft are indicated by the radial lines. The angle of deviation is that between any one of said lines and the next division of the outer circle ahead of it.

Referring to Fig. 1, the velocity of the driven shaft is a minimum at J and E, that is at 0 degree and 180 degrees and a maximum at C and G, that is at 90 degrees and 270 degrees. This is true for all angles of the shafts. The velocities of the two shafts are equal at B, D, F and H, about 45 degrees, 135 degrees, 225 degrees and 315 degrees. This varies a very little with different shaft angles ø. From H to B the driven shaft is moving slower than the driver and from B to D faster. It is assumed that there is the normal angle of 90 degrees between the actuating pins (or their equivalents) of the shafts at J. From this point to B the driven shaft is dropping behind and at the latter point the greatest angle of variation is attained. From B to C the driven shaft is catching up and again has the normal angle at C. From C to D, the driven shaft is getting ahead of the driver, until at the latter point it has increased the normal angle by the greatest angle of variation, and so on. If we assume a uniform movement of both the driving and driven mechanisms, the intermediate shafts will be twisted first in one direction and then in the other, to the extent of the greatest angle of variation.

In Fig. 2, the successive positions of the driver at equal small intervals of time are laid off on the base line. As the velocity of the driver is uniform, the base line may also represent time. The vertical lines represent the positions of the driven shaft at times corresponding to the adjacent divisions of the base line. The line $a\,b$ represents the velocity of the driver by its uniform distance from the base line, and the line $c\,d$, the variable velocity of the driven shaft in the same way. The greatest rate of increase of the velocity of the driven shaft (its acceleration) is at about 45 degrees, where the velocities of the shafts are the same. It is represented by the slope of the tangent to the line $c\,d$. These points may also be observed by reference to Fig. 1 but not as clearly and accurately.

The following points might be taken into consideration in designing a universal joint:

(a) It might be desirable to provide a shaft that would be durable when subjected to an angular deflection equal to the greatest angle of variation, four times in each revolution.

(b) Assuming a uniform velocity of one shaft, what would be the greatest and least velocity of the other shaft?

(c) Assuming that the driver exerted a uniform torque, what would be the greatest and perhaps the least torque transmitted to the driven shaft?

(d) Assuming a uniform velocity of the driver, what would be the acceleration of the driven shaft?

(e) To what torque might the driven shaft be subjected, in view of (c) and (d)?

a

In the accompanying table the third column gives the greatest angle of variation for the angle ø of the shafts given in the first column. The shaft will be twisted to the extent of this angle both ways, as ordinarily adjusted and constructed. Intermediate values may be calculated by the simple empirical formula $V = 0.27ø^2$, the degree of approximation is shown by comparing the values of column 2, which were calculated by this formula, with those of column 3 calculated by the rational formula. This empirical formula may be easily combined with the formulas for the strength and resilience of shafts to obtain a formula for calculating the dimensions of the shaft. The angle ø is taken in degrees and the result is in minutes of arc.

Angle Between Shafts.	Greatest Angle of Variation of Driven Shaft—Empirical Formula.	Greatest Angle of Variation of Driven Shaft—Rational Formula.	Coefficient of Greatest Velocity.	Coefficient of Least Velocity.	Coefficient of Greatest Acceleration in Radians per Second per Second, Using Revolutions per Minute.	Coefficient of Greatest Acceleration in Radians per Second per Second, Using Radians per Second
ϕ	$V = 0.27\ \phi^2$		$\frac{1}{Cos.\ \phi}$	$Cos.\ \phi.$		$4\frac{sin.^2\frac{\phi}{2}}{\sqrt{cos.\ \phi}}$
5°	0° 6.75′	0° 7′	1.004	0.9962	0.00008362	0.007625
10°	0° 27′	0° 26′	1.015	0.9848	0.0003358	0.03062
15°	1° 0.75′	1° 0′	1.035	0.9659	0.0007604	0.06934
20°	1° 48′	1° 47′	1.064	0.9397	0.001364	0.1244
25°	2° 48.7′	2° 48′	1.103	0.9063	0.002158	0.1968
30°	4° 3′	4° 7′	1.155	0.8660	0.003157	0.2879
35°	5° 30.75′	5° 42′	1.221	0.8192	0.004382	0.3996
40°	7° 12′	7° 36′	1.305	0.7660	0.005362	0.5346

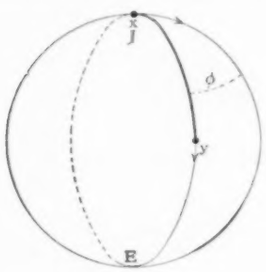


FIG. 3

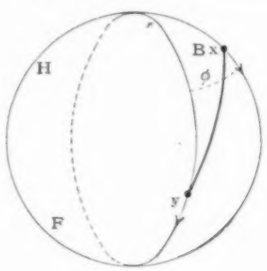


FIG. 4

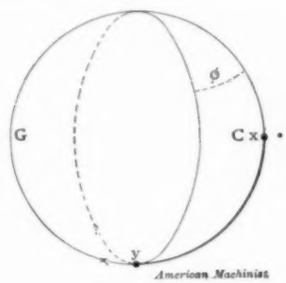


FIG. 5

DIAGRAMMATIC VIEWS OF UNIVERSAL JOINT IN THREE POSITIONS

b

If the velocity of the driver is multiplied by a value taken from column 4, the greatest velocity of the driven shaft will be obtained for the corresponding angle ø, of the shafts, and if multiplied by a value taken from column 5, the least velocity will be the result. Thus if the angle of the shafts was 20 degrees and the velocity of the driver was 600 revolutions per minute, the greatest velocity of the driven shaft would be 600×1.064 equals 638.4 revolutions per minute, and the least velocity 0.9397×600 equals 563.82, a variation of 638.4 — 653.82 equals 74.58 revolutions per minute.

The greatest angle of twist is 1 degree 47 minutes.

c

With parts rigidly connected the force transmitted is inversely as the velocities. If, therefore, we divide the assumed uniform torque of the driver by the proper value in column 5, we shall have the greatest force transmitted, neglecting in-

ertia. Thus, if we assume a driving torque of 175 pound foot units, the greatest torque transmitted, with the shaft angle assumed, would be $\frac{175}{0.9397} = 186$ lb. ft. The same result would be obtained by multiplying by the corresponding value given in column 4, because these numbers are reciprocals.

d

The maximum acceleration of the driven shaft, the driver being assumed to have a constant velocity, may be obtained by multiplying the square of said constant velocity taken in revolutions per minute, by the proper number taken from column 6, or, taken in radians per second, from column 7, in either case the product is radians per second, per second. Thus, in the case assumed, the acceleration is $(600)^2 \times 0.001364 = 491+$, radians per second, per second. Six hundred revolutions per minute is about 62.8 radians per second. $(62.8)^2 \times 0.1244 = 491-$.

The greatest rate of increase of velocity occurs from about 45 degrees to 55 degrees. If therefore we find this increase between these angles and multiply it by the reciprocal of the time, we shall have an approximation to the maximum acceleration. Thus in the above example with the shafts at 20 degrees and the velocity of the driver 600 revolutions per minute or 62.8 radians per second, the velocity of the driven shaft with the driver at 45 degrees is 62.68 radians per second, and at 55 degrees it is 64.04 radians per second. Then the increase of velocity, when the driver is turning this 10 degrees, is $64.04 - 62.68 = 1.36$ radians per second. The time is 1/360 of a second.

$$1.36 \times \frac{360}{1} = 489$$

radians per second, per second: A fair approximation to 491 as above given.

e

To obtain the torque due to inertia we have only to multiply the acceleration by the moment of inertia *I*, of the driven part.

Suppose we assume that a flywheel is being driven, which has a rim with an effective radius of 9 inches = ¾ foot weighing 150 pounds. To find the moment of inertia we divide the weight of the rim by 32.2 and multiply by the square of its effective radius taken in feet. Thus

$$I = \frac{150}{32.2}\left(\frac{3}{4}\right)^2 = 2.6203.$$

Multiplying by the acceleration 491, gives a torque of $491 \times 2.6203 = 1286$ pound-foot units.

By referring to the figures, it will be seen that when the acceleration is greatest the velocities of the shafts are about equal, so to get the total torque transmitted we have simply to add 175 (the driving torque) to the above, thus 1286 plus $175 = 1461$ pound feet, which acting at, say a 3-inch = ¼-foot radius, equals $1461 \times 4 = 5844$ pounds that would have to be borne by the articulations of the mechanism.

The data here given are intended merely to afford convenient means for calculating limiting conditions. Within these limits the judgment of the designer will be exercised.

Formulas from which these results have been derived may be found in numerous books dealing with the mathematics of mechanisms, such as "Kinematics of Machinery," by Prof. John H. Barr, and Herman's translation of Weisbach's "Mechanics of Engineering," Volume 3. Also Unwin's "Machine Design."

The expression over column 7 of the table;

$$4\frac{\sin.^2\frac{\phi}{2}}{\sqrt{\cos.\phi}},$$

which multiplied by w^2, the square of the angular velocity, will give the maximum acceleration of the driven shaft; was derived by Chas. W. Burrows, of the Bureau of Standards, and myself, as given in an article published in the *Horseless Age*, September 9, 1903.

Odd Number of Teeth in a Clutch

By John E. Sweet

I have always had the greatest admiration for the man who, by a single thought, devised something that makes simple and easy that which was, or seemed to be difficult.

In handling a Cincinnati milling machine I noticed that the clutches had an odd number of teeth, whereas every one I had heretofore noticed or made, had an even number; usually eight.

My curiosity was at once aroused, and I discovered there was reason enough for it, and figuratively speaking, wanted to pat the man on the back who hit upon the scheme.

To mill an even-tooth clutch it is necessary to set the machine twice; first, to cut one side of the teeth and then the other; but to cut an odd number of teeth it is necessary to have only a plain mill, thick enough so that twice through will cut the wide part of the gap, and thin enough so that it will pass through the small part. This will be best understood by referring to Figs. 1, 2, 3 and 4.

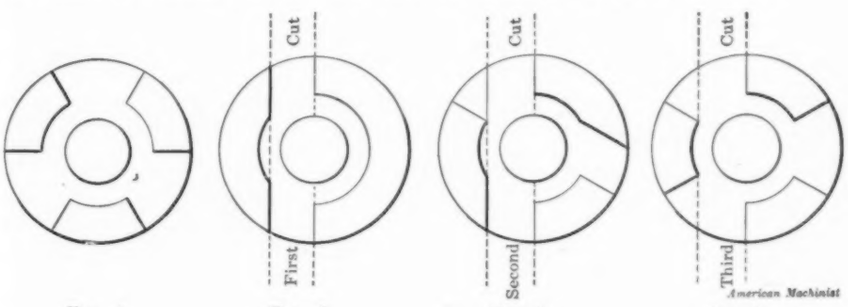


FIG. 1 FIG. 2 FIG. 3 FIG. 4

SUCCESSIVE CUTS IN PRODUCING AN ODD NUMBER OF TEETH

Fig. 1 shows a finished three-tooth clutch; Fig. 2 a single cut with a proper thickness milling cutter set with one side exactly central; Fig. 3 the second cut, which finishes one tooth; and Fig. 4, the third cut, which finishes the other two teeth, completing the job.

A clutch with any odd number of teeth can be finished in the same way, and if one side of the cutter is exactly central the clutch will be a mechanical fit.

Concrete Patterns

In a paper read before the Pittsburg Foundrymen's Association, dealing with pattern shops, concrete patterns for castings were made the subject of some discusssion. The example of a shell-like casting for a gear case was mentioned which was modeled in clay and an impression made in plaster of the male side, which was to be the drag. By processing a reverse was made, and the female poured, from which the cope was constructed. The author of the paper then proceeds to say:

These were poured in hardened concrete in an iron flask, allowed to dry, rammed up separately, put together and poured from hand ladles. We never had a pattern, but got a fine, perfect casting; size about 18x30x13 inches deep, 22 indentations, bosses and oil courses, irregular in shape, ¾ inch thick, weight 228 pounds; all from blueprint ¼ size. One hundred castings from an ordinary concrete pattern are possible and then make a new one for less than you could patch up, varnish and store a wood pattern.

Operations in Forming and Bending Brake Beam Parts

Utility of Simple Dies and Long Life of H. S. Steel Punches

Special Correspondence

When we consider the thousands of freight cars used in the United States, to say nothing of passenger cars, the question of brake beams assumes considerable importance, in view of the part they play in making modern railroad traveling possible. For, strange as it may seem, if it were not for the ability to stop quickly, high speed would be practically impossible in railway work.

The plant of the Buffalo Brake Beam Company, at Buffalo, N. Y., adjoining what is known as the old Lackawanna village, with its five hundred brick houses so nearly alike that it seems almost impossible for a man to pick out his own abode even when sober, has a number of very interesting operations in bending, punching and forming the various parts that go to make up a complete brake beam.

Fig. 1 shows the nine stages of the brake-beam fulcrum in which the air-brake lever swings and which has a number of very interesting features. The bar steel is cut up into straight lengths, as shown at the extreme left and after being heated, the first operation is to place it in the breaking-down dies at *B*, Fig. 2, which bend the ends in the shape shown. It then goes to the twisting or forming dies, which put it into the third position. This twist varies according to the design of the brake beam, which has to be made to fit specifications submitted by different railroads. This is a somewhat unusual bending or forming operation and a careful study of the dies will show how this is accomplished. The end of the piece is carried down straight by the back part of the upper die, bending it over the block shown and after the piece is firmly held by this part of the die the front portion begins twisting it to the desired angle.

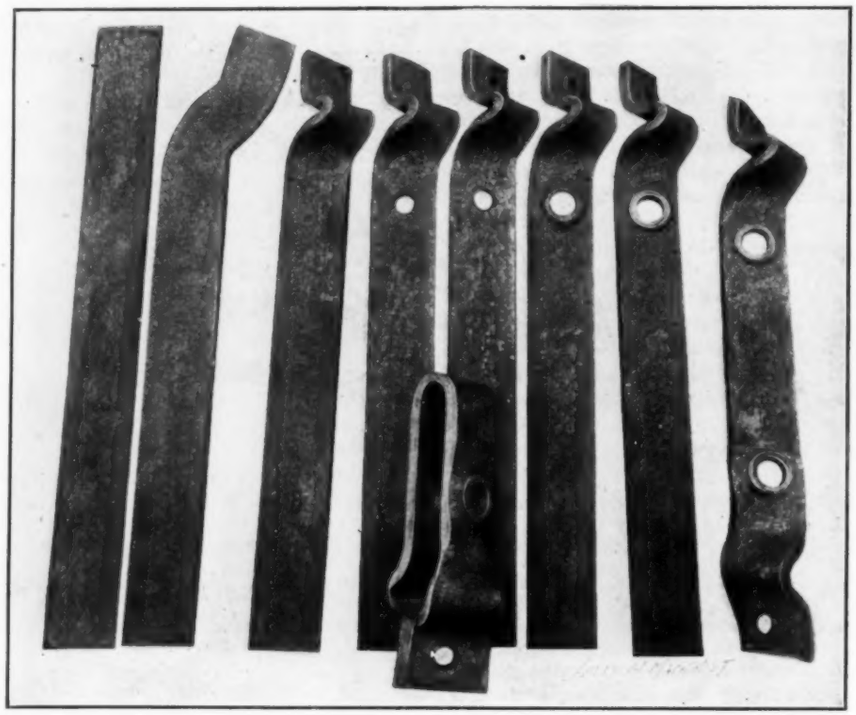


FIG. 1. NINE STAGES OF A BRAKE-BEAM FULCRUM

The next two operations are simply punching, first with *D* and then *E*, but operations *F* and *G* are interesting as being out of the ordinary. The punch *F* bulges the metal around the hole which has already been punched, shown in the sixth piece, while *G* may be called a flattening punch, which forces the raised metal

FIG. 2. HOW IT IS FORMED

FIG. 3. ASSEMBLING A PLAIN BRAKE BEAM

down to the desired hight above the bar and makes a flat face on the raised portion.

The last piece shows the appearance after both ends have been treated, the next and last step being to bend them in the center into the finished fulcrum as shown in the front of the others. This is done by a projecting ram at the extreme left of the press, which forces this between the jaws shown at *A*.

These fulcrums are put onto a brake beam of I-section as seen in Fig. 3, so that the brake lever lies at an angle with the beam.

Fig. 3 shows the way in which these brake beams are assembled. The I-beams are delivered the right length from the steel mill, are punched in the ordinary way and slid to an assembling bench to have the fulcrum and brake-shoe holders held in place. They are first put on the spacing bench at the right, which shows at a glance whether the end pieces are the right distance apart and after this is determined they are lifted to the riveting bench shown at the left. This is covered with sheet metal where the beam lies and the three rivets are driven by the pneumatic riveter shown at a very rapid rate. The other end of this riveting bench leads to the loading platform so that no time is lost in handling from start to finish.

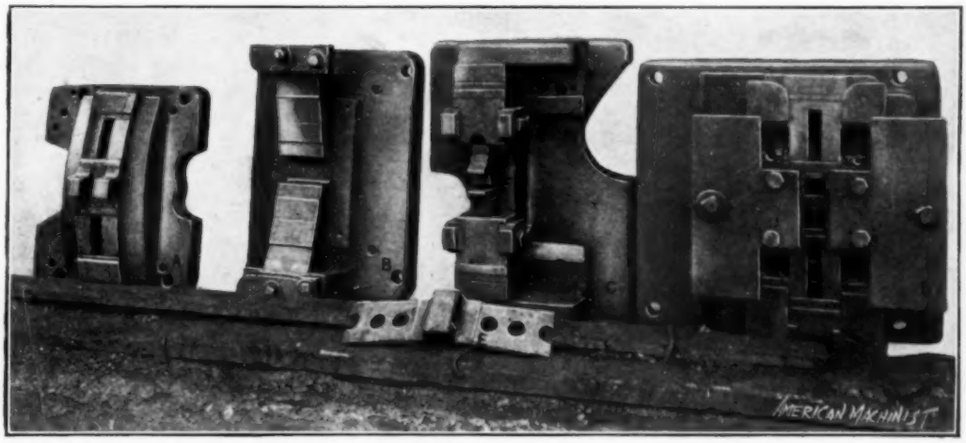


FIG. 4. FORMING THE BRAKE-SHOE BACKS

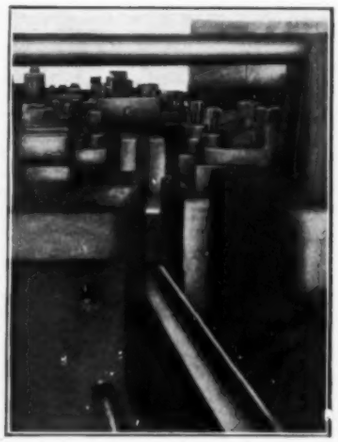


FIG. 5. FORMING THE END OF A TRUSSED BEAM

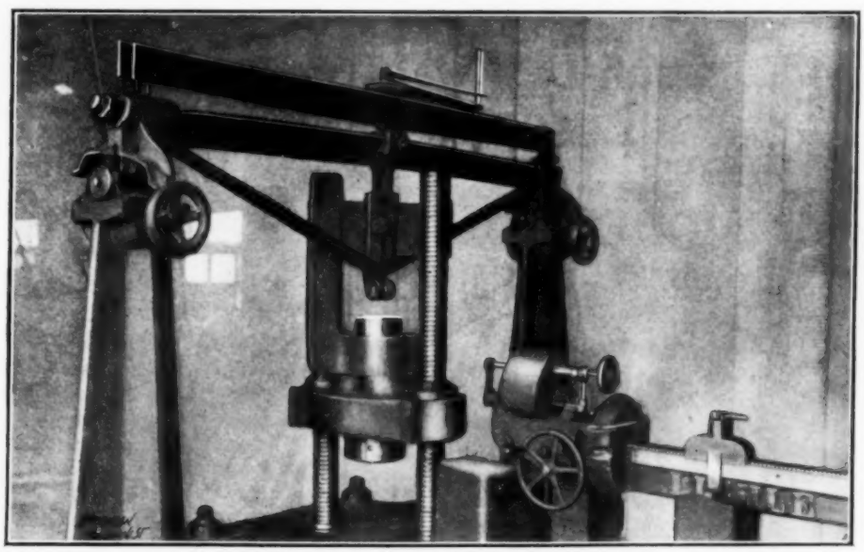


FIG. 6. TESTING A TRUSSED BEAM

LONG LIFE OF PUNCHES

High-speed steel is used for all punches and dies on cut work, the dies being counterbored from the back so as to leave only about one-quarter inch thickness at the actual punching hole. The allowance on 11/16-inch punches is 1/32 inch for hot work. Air-hardened Ajax steel is used and is said to last on the average for approximately 500,000 holes. For cold punching carbon steel is used and the allowance between punch and die is reduced to 1/64 inch for the same sized punch.

In Fig. 4 are shown some interesting dies for punching steel brake-shoe backs. Dies *A* and *B* simply form the shoe into the desired shape, putting the cross-channel at the center. Dies *C* and *D* show the second operation, in which the cutting points *F* shear the central portion and force a tongue down on each side so as to form a pocket for the key which holds the brake shoe in place. This work is done under the heavy presses, although it might be easily handled in a bulldozer.

In Fig. 5, an Ajax bulldozer is shown at work on the end of a T-section beam, which forms the upper section of a trussed brake beam. The die *A* holds the web in position while a lower die

rounds the end to fit in a malleable iron pocket, as shown at the end of the beam on the testing machine in Fig. 6. This makes a very simple construction as the two end pieces simply slip over the two beams which had previously been given a camber. These pieces hold the brake shoes and also form thrust blocks for the truss rods.

An idea of the rigidity which is obtained by this construction can be had by the fact that brake beams are tested so that with a load of 15,000 pounds the limit of the deflection at the center, as indicated by the multiplying lever, must not exceed 0.0625 inch and must return to its original position without any set. Some beams of every lot are destined to destruction, which simply means that the truss rod stretches beyond its elastic limit. This requires in the neighborhood of 48,000 pounds applied at the center. The tests are thoroughly conducted and insure safe working conditions.

It is interesting to note the rocking pin bearing under each end of the beam to allow free adjustment for the downward pull and also the attachment which indicates the amount of deflection. We are indebted for these photographs to both F. A. Crone and C. J. Zacher, president and superintendent of this company. F. H. C.

The Huber Rotary Centrifugal Hammer

Following along the lines of the modern tendency to substitute rotary for reciprocating motion, as in the steam turbine and centrifugal pump, are the Huber centrifugal hammers, shown in the accompanying illustrations.

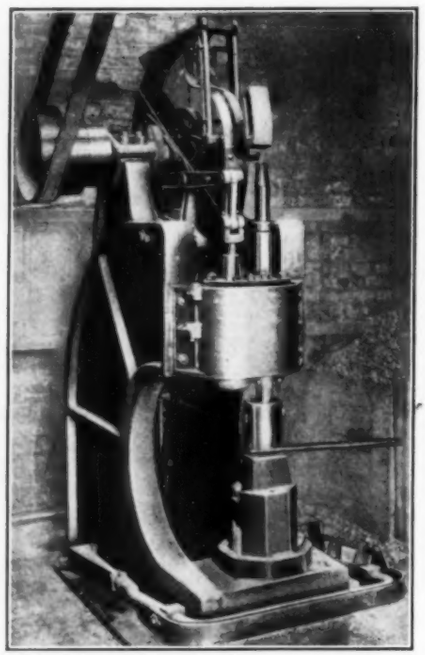


FIG. 1. HUBER'S COMBINED ROTARY HAMMER WITH GUIDE STRIKING HEAD

DIRECT ACTING HAMMER

Fig. 2 shows the simplest or direct-acting hammer, but Fig. 3 shows how it has been modified and improved. Referring to Fig. 3, to a rotating disk A two guiding rods L are flexibly fixed and their ends are connected by a draw rod Z. To the end of each guiding rod a hammer H^1 H^2 is also attached. These guides are so arranged that they can swing inward and outward to a certain extent so that, for instance, the right hammer H^1 is further from the center and describes a larger circle than the hammer H^2, which is connected to the first hammer by the draw-rod Z. The hammer H^1 will, therefore, exert more centrifugal force than the hammer H^2 and will therefore cause the hammer H^2 to describe a smaller circle than it itself describes.

The preponderance of the right hammer H^1 over H^2 lasts only so long as it is unchecked in its flight. The instant it strikes the forging it expends its energy (which is then converted into force of impact and recoil) and also loses its centrifugal force. In the meantime the flight of the hammer H^2 will have remained unchecked and it will, therefore, have retained the full centrifugal force which enables it to swing out and draw back the hammer H^1, by means of the draw-rod Z, into the smaller circular path which H^2 occupied previous to the blow.

This cycle of operations takes place automatically with each stroke and in order to convert the recoil of the hammer H^1 after striking, into useful work, a nose N is so arranged at each pivot about which the hammer swings, that it helps the hammer to rebound and to change over into its new position promptly and positively. The hammer can be thrown into and out of action at any instant, by means of a foot lever.

This hammer can be manufactured in all sizes and may be driven by a belt or by an electric motor. It is suited for flattening steel parts and for the production of swaged articles, etc., in large numbers.

As the energy available in the hammer heads varies as the square of the speed of rotation and the number of blows varies directly as the speed, the most suitable control of the work done is by speed variation. Variation of speed while working is accomplished by friction gearing.

On the periphery of the friction wheel there is a cavity just at, or a little before, the spot at which the hammer strikes the forging so that the friction wheel loses its grip just at this point. The consequence is that the stroke and the recoil can last a few hundredths of a second, giving the hammer time to change its position from right to left without being immediately dragged forward again by the driving shaft. The recoil of the hammers does not tend to damage the bolts but is taken by springs which are rigidly fixed to arms extending from the rotating frame of the machine. Each of these springs carries the guide rod of one hammer at one end and at the other, a curved piece, against which presses the above mentioned nose.

If the hammer is not to strike the anvil, by depressing and locking the foot lever the hammer is drawn in before it reaches the anvil and passes clear.

COMBINED HAMMER

Huber's patent combined high-speed hammer shown in Figs. 1 and 4, differs from the foregoing, direct rotating high-speed hammer in that the hammer head does not strike directly on the work, but transfers its momentum through a guided bar S, Fig. 4, which carries the striking head h^1, and upon which the rotating hammers strike. The purpose of this straight guided bar S is to enable articles

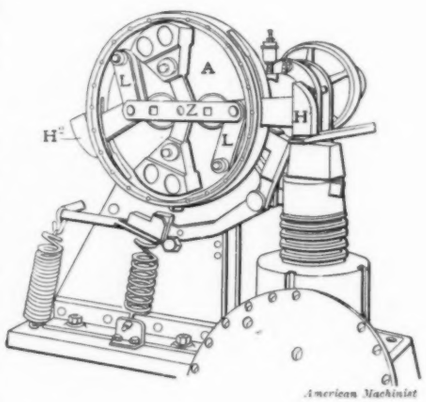


FIG. 2. PRINCIPLE OF HUBER'S DIRECT ACTING ROTARY HAMMER

to be forged with a boss and further to allow the material to stretch freely in all directions or to be forged in any given form. The action of the rotating hammers is like those already described.

In order to give the striking bar S a certain stroke (for instance 2½ inches) between blows and further to avoid the

necessity of accelerating this bar by means of the rotating heads, an advance stroke is given to the bar by means of an air-compressing apparatus. To this end a double cam *D*, situated on one side of the center of the hammer, raises a piston K_1, in the main cylinder *C*, through the double-armed lever *l*. By this means the air above the piston is compressed and driven over into the smaller cylinder *C*, where it forces the striking-bar shaft *S*, downward by its piston K_2 until the head h^1 rests upon the work. At this instant the blow of the rotating head *h* takes place. This blow alone effects the intended forge work.

Immediately the hammer *h* has exerted its blow, the spring *F* and weight of the large piston K_1 force the air to raise the piston K_2 on the hammer bar *S* and thus remove the hammer head from the piece being forged. This process is repeated for every blow of the rotating hammer heads.

It must be pointed out that the piston K_2 fits loosely on *S* and is allowed a certain play of about ½ inch so that the piston itself is not accelerated when the blow takes place. The compressed air is, therefore, not used for the purpose of executing the forging, but for rendering the dead up-and-down stroke automatic.

If it is desired to interrupt the action of the hammer at any instant, the operator presses the foot-lever *H*, at the base of the machine, by means of which the guide cam K_3 is turned to the left through a certain angle. This causes the roller *R*, which runs on the guide cam, to draw back the hammer, which is about to execute the blow, thus forcing it to pass the upper end of *S* without striking. By the same motion of the foot-lever, a bell-crank lever *W* is thrown forward by the pull-bar Z_2. This bell crank carries the above mentioned double-armed lever *L* which is connected to the air-compressing piston K_1. This movement to the right moves *L* out of the reach of the cam so that the compressing piston does not act. However, the spring *F* under the compression cylinder draws the compressing piston downward and thus forces the striking bar upward. Thus, when the action of the hammers is interrupted, the striking bar remains at rest in the highest position. A trigger holds the foot pedal down in the off position against the counterweight *G*, until released by the operator, to again start the action.

In connection with the construction it is pointed out that the rotating hammer frame has bearings on both sides. The drive is effected on the left side, while on the right side a hollow journal is bolted onto the rotating hammer frame. Through the bore of this journal passes the shaft onto which the guide cam K_3, in the interior of the hammer, is rigidly fixed by means of a rectangular section. Outside the bearing is the lever to which the pull-bar *Z*, for control of the guide cam, is connected. The rotating hammer itself is surrounded by a sheet-iron protector, but is easily accessible from the sides.

The depicted hammer serves for the special purpose of producing work with bosses and for the manufacture of forged articles in large quantities. The anvil consists of a rough, heavy, hexagonal casting.

The hammer delivers two blows per revolution. The weight of the hammer is 15½ pounds; the peripheral speed at 100 revolutions per minute, is almost 22 feet per second and delivers 115 foot-pounds of work at each blow. The speed may be varied from 100 to 400 blows per minute. A small table shows the relation between peripheral speed, the number of blows, required power and productive work.

R.P.M.	Blows per Minute.	Work Done per Minute. Foot Pounds.	Horsepower to Drive.
50	100	2,820	0.3
75	150	9,530	0.7
100	200	22,600	1.4
125	25	44,200	2.5
250	300	76,300	4.0

J. R. Weinlinger, of 11 Broadway, New York City, is representing the Huber interests in the United States.

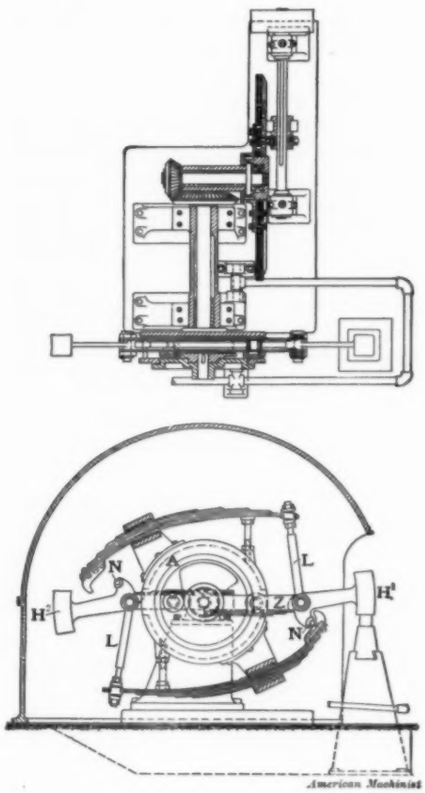


FIG. 3. HUBER'S DIRECT ACTING ROTARY HAMMER

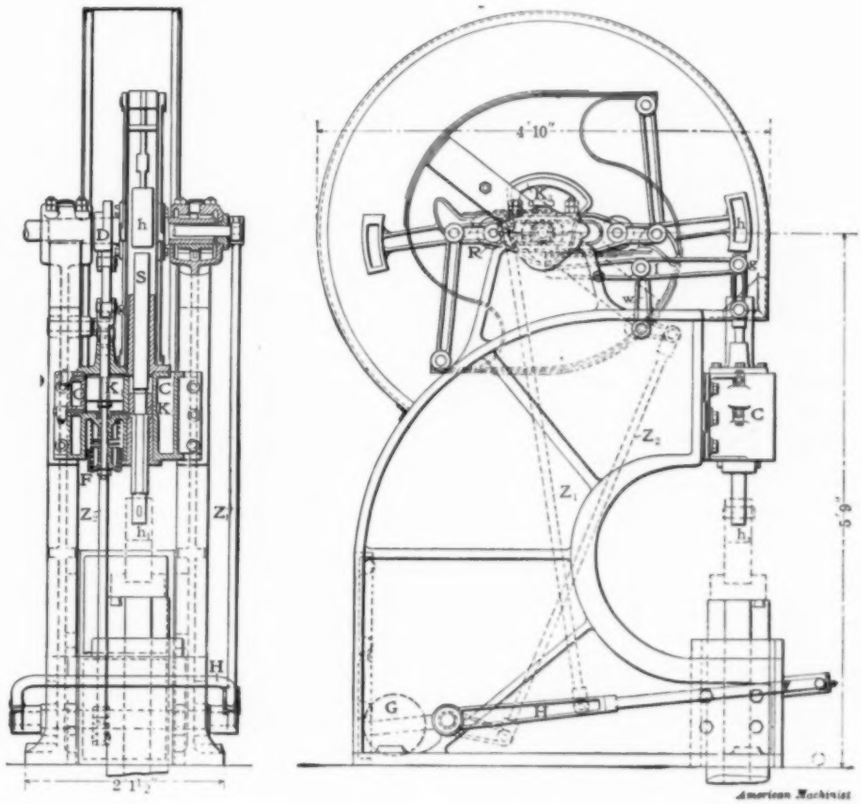


FIG. 4. HUBER'S ROTARY HIGH-SPEED HAMMER WITH GUIDED STRIKING HEAD

Letters *from* Practical Men Concerning *the* Details *of* Making things *in* Machine shops, *from the* First Sketch *to the* Sale

Planing a Beveled Segment

About 25 years ago I was employed in a shop when the firm contracted to build a turntable for a large swing bridge. The turntable was 60 feet in diameter and the contract called for true faces on upper and lower track and of a proper angle so that the wheels would now smooth without slipping. The track was composed of four rings; the two foundation rings were flat, of cast iron and one was fastened to the bridge and the other to the foundation.

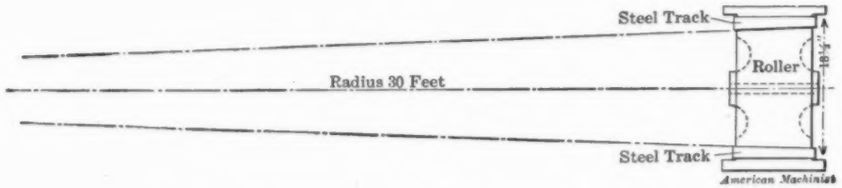


FIG. 1. ARRANGEMENT OF BRIDGE TRACKS AND ROLLER

The other two rings were steel with the segments about 10 feet long. The segments were about two inches thick and after finishing were bolted to the cast-iron rings forming the faces of the upper and lower track. Countersunk head bolts were used to hold them in place.

Between these two tracks were 74 rollers about 18½ inches diameter at large end, the rollers being turned taper as per sketch, Fig. 1. This necessitated the track being thinner on the outer edge to correspond.

As the largest lathe in the shop would swing but 42 inches, the only way to do it was to use the planer. But the difficulty was the bevel on the face.

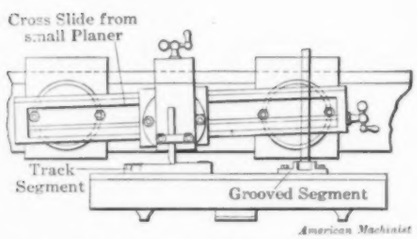


FIG. 2. PLANER RIG FOR PLANING BEVELED SEGMENTS

The way this was overcome was to make a pattern and casting, a few inches longer than the segments and about the same shape with a groove in it three inches wide and two inches deep of the same radius as the center of the track. After the groove had been cleaned this plate was bolted to the planer table alongside a steel segment. See Fig. 2. The cross-bar screw was removed, also the swivel head, and in its place was securely bolted a cross bar from a small planer, set to the desired angle for the track face. To this loose head was bolted a bar held vertical with a roller on the end, which filled the groove in the casting. As the table traveled back and forth it caused the small cross-bar to travel in an arc of a circle of radius equal to the finished track. The small cross-bar projected over the steel segments with its slide and tool and was fed across by hand. The job was very satisfactory.

AN OLD TIMER.

Tap Fluting Cutters

We have proved by actual experience that a convex cutter used in fluting taps makes a tap cut larger than it actually measures and it cuts both on the advanced and rear sides. If made to cut to a given pitch diameter, it will actually cut from 0.002 to 0.003 inch larger than it really measures. We claim that a tap fluted with a cutter, style A, page 142, "AMERICAN MACHINISTS' Handbook," will cut and retain its size closer than when milled with style B cutter.

H. SARGESON-BASTOW.

Revere, Mass.

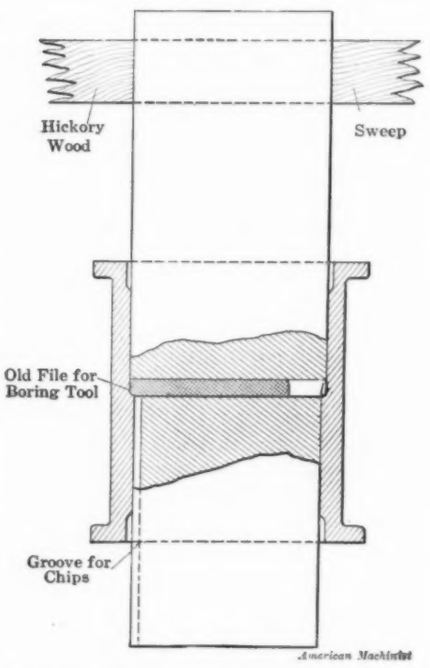
Reboring a Steam Engine Cylinder with a Wooden Boring Bar

I have read several articles in the past few months in the AMERICAN MACHINIST on reboring holes with a wooden boring bar.

Several years ago while walking along a river bank, I saw two men continuously walking around a steam-engine cylinder of the vertical type. To satisfy my curiosity I walked over to where they were and found that they were reboring the cylinder of a small steamboat engine.

When the job was finished the man raised the bar out of the cylinder and upon examination I found that they had taken a piece of hickory wood about 3 ft. long, turned about 12 inches of it down to the size of the original bore and the balance of the stick turned to the size of the new bore. At the offset was a piece of an old, flat file, driven in and ground to a good cutting edge, which made an excellent boring tool. From the cutter down to the end of the bar was a groove to take care of the chips. At the top end of the bar was a 2-inch hole with a stick through it about 6 feet long, which answered for the sweep.

The bore was about 6½ inches in diameter; the length of stroke I do not remember. I did not have anything with me for calipering the bore but from all the squinting I did down the inside of the cylinder, it appeared to me to be an A No. 1 job and that engine is still giving good service on a steamboat. It has not been rebored since.



REBORING AN ENGINE CYLINDER WITH A WOODEN BORING BAR

Janesville, Wis. OBSERVER.

Discussion *of the* Previous Question

Letters from Our Readers Showing how many Men of many Minds Look upon Various Subjects Opened up in previous Numbers

Straightening Hardened Spindles

I note E. M. King's experience, described on page 148, in straightening hardened spindles that were made of Jessop's annealed tool-steel. While of course the spline was the cause of the distortion to a certain extent, yet it is just possible that the heat on the spindles was somewhat higher than would have been necessary. As they were not to be ground, if he had added animal charcoal dust with the wood charcoal, in about equal parts, and heated them in this mixture in a cast-iron box, and quenched them in oil, he would have had a great deal less trouble and possibly a better job, as this method would only harden the outside, and leave the center soft.

If the pieces were to be ground then they should be heated without being packed and quenched in oil, as a piece of Jessop steel 0.035 inch in diameter will harden in oil sufficiently for a spindle and the spindle will be much stronger heated in the ordinary way than if heated packed in charcoal. One other serious mistake he made was in not using oil for doing the straightening and a thermometer to gage the heat, which should be higher than the spindles would be subjected to in use. This prevents them from changing until their temperature reaches a point higher than the heat given in the straightening or drawing of the piece. As Mr. King had a great deal more trouble in straightening his pieces the second time than he had at first, he should have worked on that theory to solve the problem. There can no good come from heating up a piece after rough grinding. All this work should be done previous to any grinding. The reason the spindle was 0.0015 inch over size after hardening was that the heat produced this change. In the third operation of straightening he allowed the piece to cool under pressure, while previously he had been dipping them in water to cool. He states that he finds this more satisfactory and that he straightened the remainder of the spindles without using water. I do not think this had any bearing on the general results. His entire trouble was in not using sufficient heat to set the grain of the steel and thus prevent its changing when subjected to the heat generated by use.

In placing steel in a cast-iron box, packing it and then heating and quenching in water, we do not get the same results in the grain of the metal as we would if it were heated in a lead bath or open furnace. We must also remember that we do not want, or at least it is not best to have one grain for all kinds of tools and work, or even the same grain for all spindles. We must regulate the grain of the steel in accordance with the use to which it is to be put. A spindle needs only a wearing hardness as is the case with a gear. If the gear or spindle

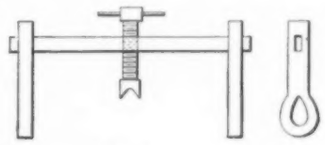


FIG. 1

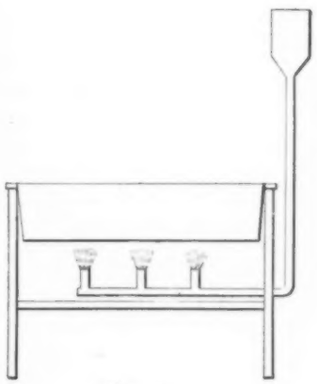


FIG. 2

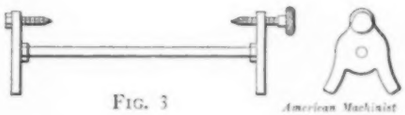


FIG. 3

APPARATUS FOR STRAIGHTENING SPINDLES

is to withstand heat and shock it will be necessary to have them tough only. If these spindles had been drawn to 500 degrees Fahrenheit there would have been no change in them, in the second heating, without pressure, as long as the second heating did not equal the first heating. Therefore where work of this character is being done, it is essential that we apply sufficient heat to the spindle previous to their grinding to permit us to be sure of their being no change when heat is again applied to them or when they become heated by usage.

With a U-shaped clamp such as is shown in Fig. 1, the straightening can be accomplished more readily than in a bench lathe. In the straighetning of tools, a heat of 390 degrees is usually sufficient to set the grain so no trouble will arise from warping. I allow my heat to vary from 360 to 400 degrees when straightening tools. The method of using soft solder to determine when the grain of of the steel will take a set, as pressure is applied, is all right where but a few tools are to be straightened, but if any great amount of this class of work is to be done, an oil tempering bath and thermometer should be provided so that the work can be done with positive knowledge. To straighten work by using a flame to heat the piece, requires a great deal of skill and we too often overdraw one part while not drawing other portions sufficiently to even relieve the strain.

If a number of pieces are to be straightened the time required for doing the work will nearly equal the price of a tempering furnace, which can be built for a few dollars. Let us say we had a hundred of these spindles to straighten. The time required for the doing of this work if the proper appliances were supplied, would be about two hours of the helper's time, whereas to straighten them in a bench lathe it would require from 3 to 4 days of the machinist's time, and the work would not in any wise equal the work done by the helper with the aid of a thermometer. A tempering bath such as is shown in Fig. 2 and straightening device with indicator attached as shown in Fig. 3, and a few of the U-shaped clamps shown in Fig. 1 and a thermometer would complete the oil tempering and straightening outfit. This bath should stand about 28 inches high and can be heated with natural gas or by 3 burners such as are used on the ordinary gasolene stove. Including the thermometer, $25 will complete the outfit. Then why should we allow a machinist to sit at the bench lathe with an alcohol torch and apply heat and then solder; if the solder does not melt, apply more heat and solder and so on; whereas if provided with suitable appliances, it would soon pay for itself, by the difference in the cost of the work.

The oil bath should be provided with a hood sufficient to withstand fire, as it is liable to become overheated and blaze; it also provides means for the fumes of the oil to escape. I have found winter-strained lard oil to be the best to use in the tempering bath. It has a high igniting point of 652 degrees Fahrenheit and does not give any trouble from boiling before the heat reaches this point. It is necessary to remove all the oil when it becomes too low or too heavy, as to add

new oil (or a small amount of water) will cause the bath to boil over when heated and throwing it all out of the tempering pot. If these points are guarded, no trouble will arise from the use of an oil bath.

When removing work that is being straightened, from the oil, submerge it in hot water and withdraw it instantly. This causes the water to boil and remove all grease from the clamps and work. After this return it to the water to cool so it can be handled. Release the strain and place on centers; repeating the operation until the piece is straightened. With a few trials, the operator will become proficient enough to do the work at one heat. By using two clamps the work can be made continuous and no time lost by waiting for heats unless the work is large. More time is then required for the piece to reach the heat of the oil. The above method is not only safe, but is much more rapid and the mechanical way to do this work in quantity. It is also the best method to use in the drawing of tools as it insures accuracy.

Davenport, Iowa. C. U. SCOTT.

Patent Interferences

Mr. Alford's article on page 106 does not carry the conviction which its length might imply. It is an interesting statement of facts with several strong accusations.

Let us look into the matter carefully. It is said that the fact that 30 interferences were declared out of 94 applications filed by Mr. Leonard is presumptive evidence that the inventions are of value. The value of an invention has nothing whatever to do with the declaring of an interference. The Patent Office would be obliged to declare an interference when two applicants made the same claim, whether the invention was for a glass eye or an adding machine.

Mr. Alford says that these records of Mr. Leonard's show that many patents issue whose applications should have been put into interference with other applications pending at the same time in the Patent Office. Not being able to look over the records of Mr. Leonard and note the wording of his claims and the wording of the claims in the case of the alleged interfering applications, we cannot contradict the statement as far as it applies to these cases. It is certainly doubtful, however, if such a general statement can be made as to all cases, and it seems improbable that Mr. Leonard's cases show such a fact, in view of the frequency with which applicants are prone to think they should have been placed in interference when they are not entitled to one. Interferences are not declared simply because two inventors are working out the same principle, or are working on the same machine. They must make substantially the same claim. To change the law to permit interferences on greater differences would be to increase the burden on the applicant and do a real injustice.

Many times a patent issues and an inventor, having an application in the office, says at once that he should have had an interference, and he would have had one *provided* his application had had claims as broad as it was entitled to have. This may have been true in Mr. Leonard's cases. For instance, an inventor applies for a patent in which the invention is claimed on its specific construction; another inventor in the same field accomplishes the same result by a different construction and applies for a patent at about the same time but files broad claims. The Patent Office has got to accept an application as showing and claiming all that the applicant is entitled to. In this case the first man is not entitled to an interference with the broader claims and such an interference would be an injustice to the second man. Yet if the second application with the broader claims is issued first the other applicant is very apt to say, "Why, I could have made claims as broad as those! The office had no business to let that patent issue. There should have been an interference." Now in Mr. Leonard's case he demanded interferences with these alleged inadvertently issued patents. Did his demand in each case consist in copying the claims of the issued patents in order to force an interference? Or did he simply demand the interference on the strength of his claims which were in the office while the other cases were pending? If the former it is pretty safe to say that the claims were so different as not to show interference in fact and to free the office of any improper action. If the latter it would seem to be true that the office had erred.

Mr. Alford complains that in the interference with Cutler, Leonard was obliged to be to the expense of appeal after appeal, even though his date of filing was previous to Cutler's date of conception. It is true, however, that subsequent acts of one first to file can be held to have lost that advantage. Cutler had a perfect right to find out whether Leonard's abandonment of application had resulted in abandonment of invention. If it had, Cutler would have then had a valid patent. That this question was not without a doubt was shown by the fact that the examiner-in-chief decided in favor of Cutler. Furthermore, who then exercised the right of appeal? Why, Leonard, to be sure. If he had not had the right to appeal when the other man won, we would now be hearing of the injustice of lack of proper appeal.

Now Mr. Alford says pressure must be brought to bear upon Congress to modify our patent laws. What has he shown that can be improved by law? The case given the most prominence, the first case, the examiner did not declare an interference when the cases were both pending, because in his judgment no interference existed. Those higher up said he was wrong. Now how can any law compel the examiner not to make any mistake of judgment? To try to cure this "injustice" by bringing pressure on Congress would be like passing a law that no railroad man should cause a wreck. In the other cases there is nothing to show that the examiners did not consider the cases not entitled to interference when they were all pending.

To take away the right of appeal when one person is prior in filing date to the other's conception would probably do more harm than good. There are other things to be considered besides filing dates.

There is one point regarding appeals which might be of benefit, although Mr. Alford does not mention it; the commissioner has advocated in his annual report the eliminating of one appeal in the office, that of the examiners-in-chief, and making the examiners-in-chief, the commissioner and the assistant commissioner, a single judicial body. This board would consider appeals direct from the primary examiner.

There seems to be but one thing mentioned by Mr. Alford which could be improved by law, and that is the fact that an applicant who wins over a patent in an interference proceeding can only take a patent with similar claims. The commissioner should be given power to cancel a patent upon proof of its invalidity. But this advantage would not be limited to interference proceedings; it could, and should be invoked on patents invalid for two years' public use, prior invention, etc. But this relief would be cause of more of the very thing complained of by Mr. Alford. It would be another piece of litigation which any patentee might be called upon to defend.

Lowell, Mass. IRVING D. KIMBALL.

An Indexing Job

I think the indexing job described at page 31 could have been done quite near enough on a Cincinnati dividing head, using the 54 dividing plate. As

40 turns of the dividing head = 360 degrees,

1 turn = $\frac{360}{40}$ = 9 degrees,

1 degree = 1/9 of a turn = 6 holes in the 54 circle,

1 hole = 10 minutes.

With this plate the nearest we can get is 22 degrees 20 minutes = 2 turns 26 holes in the 54 circle, but the error, which is exactly a quarter of the distance between the holes in the 54 circle, is so slight that it is scarcely appreciable and could safely be neglected.

Glasgow, Scotland. H. B.

Cause of Tools Checking when Grinding

In the AMERICAN MACHINIST on page 222 appears an article entitled "What Causes Checking in Fine Finishing Steel Tools?" As the writer of the article in question desires information on the subject, or suggestions that would help him out of his troubles, I will venture a few suggestions that may be of use to him, although it is not always easy for one at a distance to determine the exact cause of the trouble at first, as there are so many seemingly small details that enter into the question, which if omitted might cause one to judge incorrectly. As Mr. Scott states that the steel is in first-class condition, and is hard and will stand severe tests after hardening and before grinding, I can but agree with him in thinking that the trouble is in the grinding. Mr. Scott states that they use water in grinding but that even then some of the pieces are found to be soft on the surface after being ground, which leads me to believe that the trouble lies in the grinding, and in the wheel, as I think that with an improper wheel the temper can be drawn on hardened work even with considerable water flowing on it all the time, and I am inclined to think that if the work becomes heated enough to draw the temper with water running upon it, the unequal expansion caused by the surface becoming hot, while the central portions remain cold, would be sufficient to cause the checking mentioned.

Were I to suggest a remedy for the trouble, I would begin with the grinding wheel, which (and I can only judge from Mr. Scott's statements of the manner in which the work comes from the grinder) is too hard, or grit is too fine, or both. I would try a softer wheel, and perhaps one of coarser grit also. A wheel that would wear away faster would be less likely to generate heat enough to cause the work to be soft after grinding, and while it might cost more for the proper kind of wheel in the first place, and they might need to be renewed oftener than a harder wheel that would wear longer, still I believe that it would be cheaper and more satisfactory in the end.

I believe that if Mr. Scott would take some of the leading or reliable grinding-wheel manufacturers into his confidence they would be able to help him a long way out of his troubles. Mr. Scott says that he is using all the precautions possible in the selection of the wheels, and I am not saying but what he may be, and yet the fact remains that he is not getting the results which he desires, which also leads me to think that there must be wheels made which are better suited for the purpose for which he is using them. The steel upon which he is using them is different and requires a very different wheel from one that might be entirely satisfactory used on ordinary carbon steel. We would hardly think of using a cutting-off tool to do the work of a diamond point in lathe work, and yet we often seem to think that a grinding wheel will meet all the requirements, no matter what they may be, or what *kind* of a grinding wheel it is.

EDMUND S. WILLIAMS.

Bridgeport, Conn.

Concrete Floors

For the heading to your editorial on page 279 you put the query, "Do Workmen Object to Concrete Floors Because They Are Hard or Because They Are Cold?" I would reply "both," because of the effect of its "coldness" on their persons and the effect of its hardness on an accidentally dropped tool.

I view with suspicion the word "cold" as registered by the personal thermometer. For example, in the shop where I am at present employed the fellow on the next vise to mine feels "cold," though the thermometer does not show a fraction of a degree of difference between the temperature at my vise and that at his. So he turns on the steam to make things comfortable. This, in addition to drying up hand-soap in the tin in my drawer, makes me think of Philadelphia during July last; and, if the boss is around in a rage then of a warmer place still! I long to open the window and sniff the gentle zephyrs that hover o'er the frozen Hudson. But courtesy forbids, unless my neighbor packs his traps and goes to work on some distant lathe.

But I meant to say something about concrete floors.

I once worked where the whole show is concrete, one of the finest tool rooms in the country. There in the winter we would feel comfortable some days, while on other days our legs would ache right up the calves; it was a sort of rheumaticky ache, but the room was warm all the time. It could not be the hardness of the floor because it was equally hard all the time (anyhow, I never dropped my 12-inch scale without at least *thinking* things about the floor). The aching must have something to do with the atmospheric conditions. Perhaps more humidity one day makes the concrete a better conductor of heat than on a dryer day.

The rough treatment that a tool receives at the hands of a concrete floor is also a factor in the workman's dislike for it. The possibilities of its effect in the calamitous event of a hight-gage being dropped are enough to send a cold shiver down the spine of a toolmaker. In fact, it cannot be said to improve any part of a machine worthy the name should it happen to fall on such a floor.

The fact that the comparative inflexibility of the concrete will transmit more of the machinery's vibrations than would a wooden floor no doubt accounts for the complaints of tiredness. Personally, I never noticed tiredness resulting from a concrete floor, but only the chilly ache. I noticed, however, the way that concrete transmits vibration, for I found it difficult, and at times impossible, to get a steady reading on my Boulet [indicator] when the planer nearby was running. I never had trouble with this on a wooden floor.

Tarrytown, N. Y. M. H. P. A.

An Electro Micrometer

A careful perusal of Mr. Murdock's interesting description of his electro-micrometer, on page 1025, Volume 32, Part 2, brought to light one or two points, both in the construction and use of the instrument that cause one to doubt whether the instrument is in any way superior to the ordinary type of spring-actuated test indicator, which tool it was seemingly designed to supersede on a certain class of work.

First, I cannot see why Mr. Murdock made his instrument with such a gear ratio that 0.001 movement of the micrometer thimble causes the contact point to move 0.040. Ability to control and minutely adjust the contact would seem to be a prime necessity in such a tool, and yet, according to the ratios given, to move the contact point, say, 0.0002 inch would require a movement of thimble *A* of 1/200 of a thousandth, and who can make this adjustment? Supposing, for instance, we were gaging a sleeve, as illustrated in Fig. 7 on the universal grinder, and the sleeve was, say, 0.0005 inch out of round, suppose also by a combination of careful turning of the thimble and a dose of good luck, we managed to get the contact point to touch the side of the hole without deflecting the needle bar more than 0.001; the sleeve being revolved, the spring of the bar would keep the point in contact with it, and the buzzer would give no indication of the shape of the hole. Had the gear ratio been reversed, a considerable movement of the thimble thus giving a small movement of the needle bar, the contact point could be accurately controlled.

I would also point out that in testing a sleeve for parallelism as illustrated in Fig. 7, the test will not reveal whether the hole is parallel or not, but will only prove whether the wall of the hole tested is parallel with the guide ways of the machine; if, instead, the hole were tested on the back side, or in other words, on the reverse wall to that on which the grinding wheel makes contact, any lack of parallelism would show double.

GEORGE E. GAY.

Manchester, England.

Catalog Misinformation

On page 198 of the AMERICAN MACHINIST, S. B. Redfield touches on a subject that has been upon my mind for some time. The subject is catalogs; their abundance of data completely foreign to the subject of which they treat and their general lack of essential information. A few samples of my trials and tribulations may prove of interest and will illustrate my criticism.

A short time ago, I was installing electric drive in a shop previously belt driven. Among other problems was the size of motor necessary to drive a disk grinder of a certain size and speed. One motor salesman said three, another five and a third thought that ten horsepower would about fill the bill. After this difference of opinion I looked up the grinder in the catalog but could not find any information on the subject of power required. This would seem to be a very important detail to the prospective purchaser but was entirely ignored. Of course, the class of work to be handled would enter into the case but it seems that there ought to be a size of motor that would answer the conditions of average use and not leave the purchaser at the mercy of the motor agent who will naturally try to sell as large a motor as possible.

Another question that came up was the furnishing of air to blast furnaces, speed of the blower to furnish it and size of motor to do the driving. The furnace catalog gave the air pressure necessary but completely ignored the amount. After measuring size of tuyeres this amount was finally determined but why could not the catalog have given us this, instead of devoting about a dozen pages to the areas of circles, properties of saturated steam, etc.? The latter information may be found in any hand book and the engineer knows where to find it, but the question of volume of air necessary would vary with the different furnaces and is, to say the least, a very unsatisfactory quantity to estimate.

Having experimentally determined the speed of the blower to furnish our air, we were confronted with the problem of size of motor. The manufacturer's catalog gave the size of chimney to give a certain amount of draft, weights of pipe, areas of circles, etc., but not a word on the subject of power. The local agent was called up on the 'phone and asked for information. After a considerable time, during which we suppose he was looking up his catalog, he confessed that he could not give us the information but would write the main office and let us know in a few days. Several days later he 'phoned us the information but after installation the power given was found to be almost double that required and the motor was exchanged for a smaller unit. It seems probable to us that some salesmen computed the above estimate and that the engineering department must have been able to give the required information, had they been consulted. If they did know why can they not place it in their catalog where it would be available, or is there some strong reason for not doing so?

We have found it the same with almost all catalogs. In one engine catalog which we have, we can find the weight and specific gravity of various materials, capacity of tanks in barrels, the ever present areas of circles, conversion tables and miscellaneous information such as the startling fact that a horsepower is equivalent to 33,000 foot-pounds per minute. The catalog gave a little information about the engines but there was no mention of their probable mechanical efficiency.

With a full set of catalogs, with their contents properly indexed, the engineer would probably have no more use for a hand book, provided he could depend upon catalog information, but, as in Mr. Redfield's case, it seems unwise to put much faith in the information, which in many cases looks as if it might have been compiled by the office boy.

Milwaukee, Wis. JOHN BAILEY.

Machine Tools in Unskilled Hands

On page 327 you have probably hit upon what to most foremen is their greatest trouble or source of annoyance. With the recent development and improvements in such machines as could at one time be operated by anyone having enough intelligence to stop and start them, has come the trouble in obtaining labor to operate them.

In most cases this class of help has to be developed from among the men who have been used to the old style of drill presses, screw machines, milling machines, shapers, etc., and most of the disasters occur during this period of development. Now I am coming to what I started out to suggest, which is to ask that the makers of these machines send out a neat card of instructions, showing the danger spots, with full instructions as to what every handle, oil hole, lever, etc., is for.

I have in mind several machines, which have been installed without a single line of printed matter being sent along, the proper operation and care of which has only been traced out by the most skilful mechanics in the shop, after, in some instances, several days' investigation.

The one principal trouble in my case has been lack of lubrication getting to the proper spot. This is being neglected by many of the makers and designers of what otherwise are almost perfect machines. Oil pipes with very small holes are used, leading by very tortuous passages to the part needing oil. I have seen these become in cold weather clogged up, without being able to blame anyone's carelessness, so that coal oil or naphtha would not run down.

I suggest to the designer to make provision for the thickest oil that can be purchased, as many shops are only allowed crude oil, and other good oils frequently thicken up in cold weather. Seventy per cent. of my new machinery stoppages and delays are caused by improper means of getting lubrication to where it is needed, which could easily be overcome, without adding one cent to the cost of manufacture of the machine.

I could say a whole lot in connection with the other 30 per cent., but will let others have a say on the subject first.

M. H. WESTBROOK.

Battle Creek, Mich.

Cracked Work Due to Grinding

Mr. Scott's experience with high-speed steel cracking upon being ground, as described on page 222 of the AMERICAN MACHINIST, is the same as I had in 1907. After a careful investigation I found the trouble was due to the fact that they were using too fine a wheel and crowding the work. After using a coarser wheel and slowing down the feed there was no more trouble with cracked work. I continued the experimental work still farther and found that if the wheel became glazed, cracks would develop in the work, also that if a wet wheel was used, and the wheel forced, cracks developed quite rapidly.

The above experiments were made on Novo cut-off tools ⅛ inch thick.

H.V.T.

Gripping Work in the Shaper Vise

On page 173 E. R. Davis offers a substitute for the device suggested by Dixie for gripping work in the shaper vise. It would be easy to imagine the condition of the vise jaws after the sharp corners of hardened angle pieces had been used upon them a few times for gripping work, assuming, of course, that soft jaws were used, for if the jaws were hard the angle pieces would get no "bite" or at least would have a grip that would be very uncertain.

As for the swiveling of the sliding jaw, there is no provision for this and it should not be attempted. The attempt to swivel the sliding jaw upon taper work is responsible for all the broken and hard-working vises that are to be found in the average shop.

Pittsfield, Mass. WILFRED GRIFFIN.

Machining Flywheels on the Vertical Boring Mill

The halftones illustrate the methods and tool equipment employed in machining gas-engine flywheels in the vertical boring and turning mill built by the Colburn Machine Tool Company, Franklin, Penn. The machine is shown as equipped with a central boring spindle which has been an important feature of this tool for a number of years, and as illustrated it is adapted for finishing pulleys and flywheels in remarkably quick time. For example, engine flywheels 42 inches in diameter by 4 inches face can be finished all over, including boring, reaming and facing the hubs, turning the outside rims, facing both edges and rounding the corners, in 25 minutes. A number of wheels of this size are shown in Fig. 1, and four other sizes are also included in this illustration, the tags giving the time required to finish the work. The machine is a 50-inch standard mill with central boring spindle and the five sizes of wheels shown are respectively 22, 26, 30, 36 and 42 inches diameter. The hubs on all these wheels have a roughing and finishing cut, are machined, reamed and faced off on one side. The rims and both edges are turned true with only one cut, which was sufficient for the purpose, as the wheels run true within a few thousandths of an inch. Had it been necessary to have a smoother finish, a second cut could have been taken on the face without adding much to the time, as this operation would be performed while the hub was being machined.

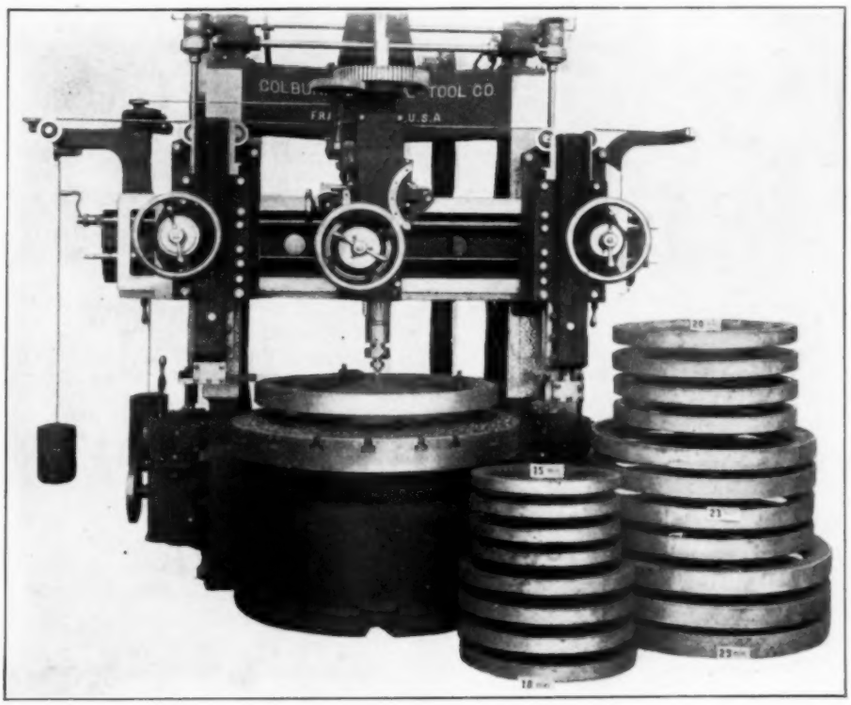


FIG. 1. COLBURN 53-INCH MILL MACHINING FLYWHEELS

In order to make such time as this, it is necessary that the tool equipment be properly designed, and arrangements made whereby the tools can be changed from one to another with the minimum loss of time. Fig. 2 shows the entire tool equipment for machining a 42-inch wheel, and Figs. 3, 4, 5 and 6 show the same tools performing their several operations. In Fig. 2, No. 1 is a boring bar; 2, a floating reamer holder, with extension for drill press; 3, a taper-shank arbor for holding shell reamers; 4, holder for cutter for facing hubs; 5, box tool for facing the outer edges by turning both edges at the same time; 6, a shell reamer to fit arbor 3; 7, pilot collars for No. 4 holder, that are used for facing hubs with different sized bores; 8, cutters for boring bar; 9, spanner wrench for floating-reamer holder; 10, tools for turning outside diameter of flywheel; 11, facing cutters for hub; 12, spanner wrench for facing cutter holder, and 13, tools for chamfering inside and outside corners.

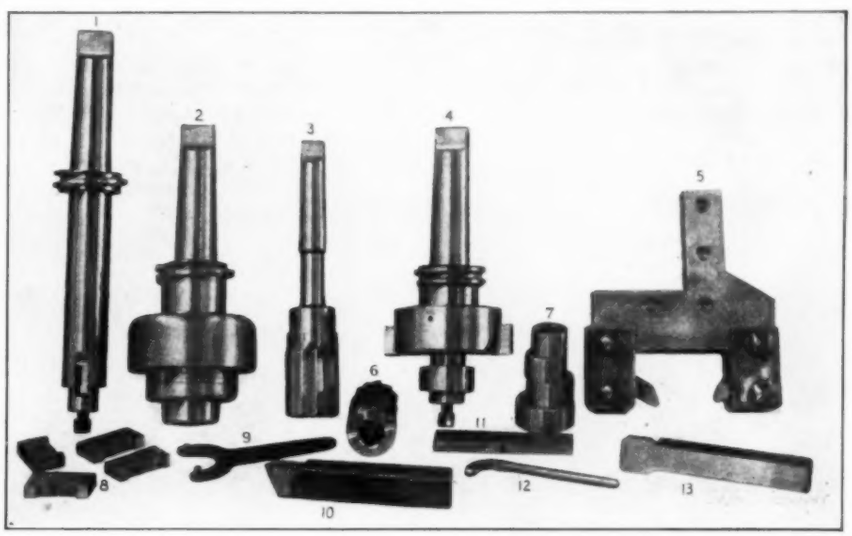


FIG. 2. BORING-MILL TOOLS USED ON 42-INCH FLYWHEEL

For quickly chucking these wheels a special fixture, as shown in the illustrations, was made for each size, which not only centers the wheel accurately, but also acts as a driver.

In Fig. 3 the rough wheel casting is shown chucked, while the different tools are machining it. The left-hand head with tool No. 10 (see Fig. 2) is taking the roughing cut on the outside of the rim. The box tool No. 5, on the right-hand head, is facing the edges, and the boring bar No. 1 with a roughing cutter, in the central boring spindle, is taking the roughing cut through the hub. Fig. 4 shows the flywheel set up in the machine just before the machining operations begin.

In Fig. 5 the wheel is shown with the outside rim and edges finished. By this time a roughing and finishing boring cut has been taken through the hub, and the illustration shows the reaming operation about to be performed. The reamer shown by No. 3 in Fig. 2, has a standard taper shank, and is held in the new floating reamer holder shown by No. 2 in Fig. 2. This was recently put on the market by the Colburn Company, and illustrated on page 969, Part 2,

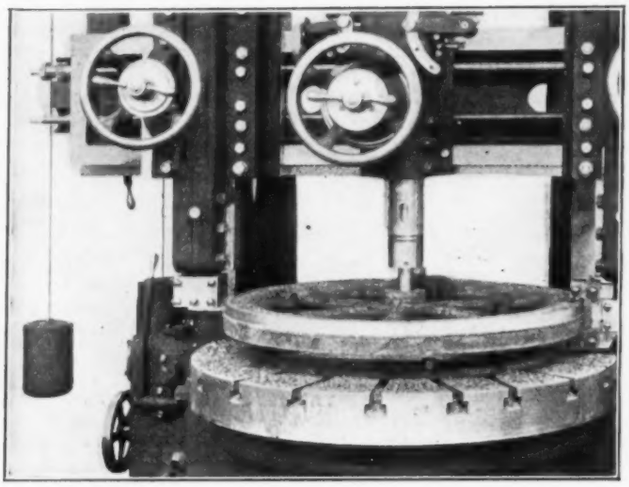


FIG. 3. ROUGH BORING HUB, TURNING OUTSIDE OF RIM AND FACING BOTH EDGES SIMULTANEOUSLY

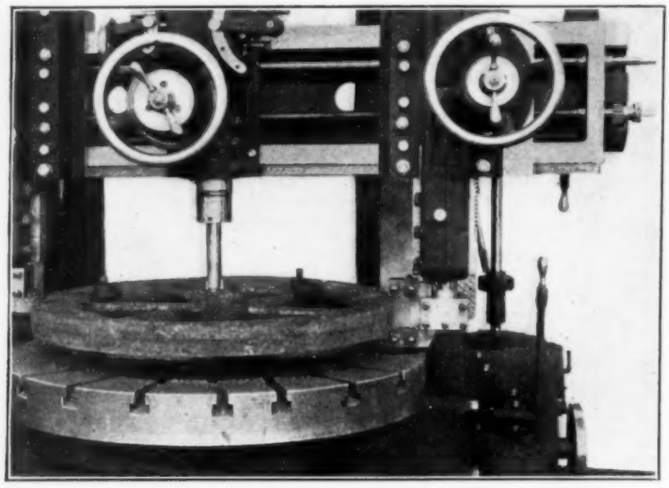


FIG. 4. 42-INCH FLYWHEEL CLAMPED AND READY TO START MACHINING. OPERATIONS SHOWN IN FIG. 3.

of Volume 32. It insures the hole being reamed to exact size.

In Fig. 6 the finished wheel is shown, as it is ready to be removed from the machine, and the chamfering tool No. 13, in Fig. 2, is shown in position in the left-hand head. This tool has four cutting faces, and chamfers the outside and inside corners on each side of the rim.

The facing tool, shown in the spindle, has taken the finishing cut on the face of the hub, and is raised above the wheel. It is shown in detail by No. 4 of Fig. 2 and consists of a shank with an enlarged hub, having a rectangular slot cut through for the facing cutters No. 11. Its lower extremity is made to hold different sized collars (No. 7) which fit the bores of different sized wheels, and act as pilots to steady the cutter.

The roughing cutter is made taper on its cutting edge, so that it does not cut into the scale all at once, but rather takes a shearing cut, which gradually feeds across the hub. In this way the cutting edge is preserved much longer than when the cutter sweeps off the entire surface of the hub at once. Of course, the finishing facing cutter is straight.

German-American Exposition at Berlin

It has been announced by the executive committee of the Berlin Exposition that instead of holding the exposition during the coming summer it has been postponed until 1911. This action has been taken for the purpose of showing good will toward Germany and German interests and to promote the commercial relations between the two countries and in anticipation of similar coöperation on the part of the commercial interests of Germany and for no other reason. As apparently this is not entirely understood, the members of the executive committee are of the opinion that it might be advisable to make the exposition a German-American affair in which both countries should participate, and thus prove it is not intended to be an American industrial invasion. With this object in view the majority of the members of the executive committee will visit Berlin in the coming summer for the purpose of bringing about, if possible, such a German-American exposition, and the United States Government has been requested to continue the honorary commission which was appointed to represent it at the exposition this summer.

On large sliding surfaces such as the guides of steam engines or on large cylindrical bearings after all other means fail to cool them try flowers of sulphur mixed with any good machine oil. It does not smell like violets but it generally does the trick.

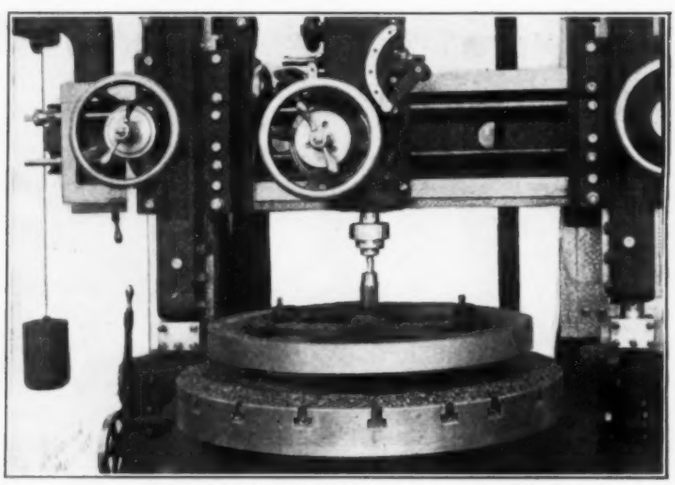


FIG. 5. FLYWHEEL ABOUT TO BE REAMED AFTER IT HAS BEEN TURNED, FACED AND BORED AS SHOWN IN FIG. 3

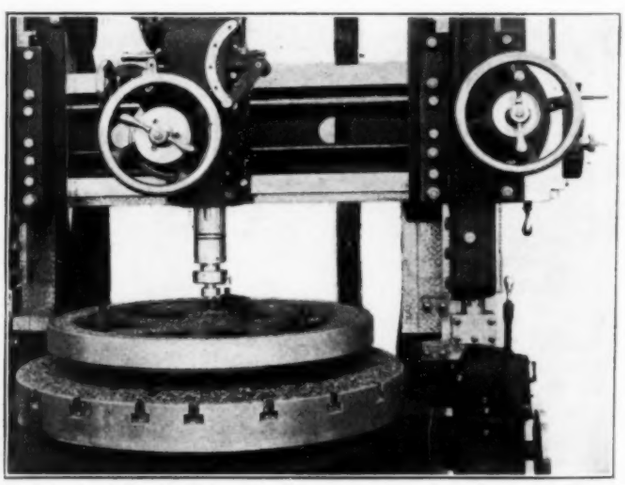


FIG. 6. CHAMFERING EDGES OF RIM AND FACING HUB

March 17, 1910.

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American Machinist

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Remarkable Radial Drilling Machines for Locomotive Work

Every mechanic who reads of the remarkable tests of radial drilling machines in this issue, is sure to be impressed with the strides in the building of machine tools which have made such results possible. When we think of the early drilling machines, with their small spindles, narrow belts, and other features in keeping with that stage of development, we are amazed at a single drilling machine that utilizes as much power as was formerly needed to run a fair-sized shop.

But the machine is not entitled to all the credit, as it has only been made possible and necessary by the equally remarkable development of the drill itself as a cutting tool. And this in turn goes back of the drill manufacturer to the maker of the steel which can stand up under the enormous strains to which a drill is now subjected.

We should not forget, however, that these machines would not have been produced but for the initiative of C. K. Lassiter, and the progressiveness of the American Locomotive Company. Their demand for radial drilling machines which should be capable of driving any drill to destruction is primarily responsible for this step in machine building and should not be overlooked.

This does not detract in the least from the achievements of the designers of the machines, for, as soon as the demand arose, their ability to meet it was clearly demonstrated, and the resulting machines are all worthy of credit. It is no mean task to design and build a machine capable of utilizing over fifty horsepower in a vertical spindle supported on an overhanging area as in these cases, and the performances of all the machines reflect credit on their builders.

Railroad shops offer many opportunities for work of this kind in the drilling of locomotive frames and similar work, where the piece is rigid and will stand any strain the tool puts on it, which is not true in many classes of work. These opportunities are no longer being neglected and we now find many examples of machine development in railroad shops that are unheard of elsewhere, of which the tire-turning lathes which are now being used in the best shops are a good example.

Everyone who is interested in machine development will study the results obtained in these tests very carefully, and while different conclusions may possibly be drawn from them, the fact remains that practical drilling machines can be built which are capable of removing from 3 to 5½ pounds of metal per minute. This is an unheard of performance and, judging from the breakage of drills is not economical in any sense. But it puts the drilling proposition up to the drill makers once more, although it is doubtful if there are many cases where the work to be drilled will stand greater strains than are now imposed on it.

CIRCULATION STATEMENT

During 1909 *we printed and circulated* 1,209,000 *copies of the* AMERICAN MACHINIST. *Our circulation for February,* 1910, *was (American weekly, American monthly, English weekly and German weekly)* 109,250.

March 3..... 40,250
March 10..... 23,750
March 17..... 23,750

This paper reaches 40,250 *separate readers each month and* 23,750 *each week.*

None sent free regularly, no returns from news companies, no back numbers. Figures are live, net circulation.

Contents

PAGE

Radial Drilling Machines Break Drills and Records..... 479
A Special Employers' Liability Policy... 482
Lathe Building Operations in Well Equipped Shop..... 483
Logarithms on a Desert Island..... 487
Lay Out of Intermittent Gears Simplified 488
The Effect of Silicon in Steel..... 489
A Central Tool Dressing Plant in a Navy Yard 490
Power Loss of a Slipping Belt..... 495
The Beverly Industrial School..... 497
Card Index for the Technical Library... 499
Various Drilling, Grinding and Milling Automobile Fixtures..... 500
Foresight vs. Hindsight in a New Shop 502
Velocity and Angular Variations of the Universal Joint..... 503
Advantage of an Odd Number of Teeth in a Clutch..... 505
Operations in Forming and Bending Brake Beam Parts..... 506
The Huber Rotary Centrifugal Hammer 508
Letters from Practical Men:
Planing a Beveled Segment....Tap Fluting Cutters....Reboring a Steam Engine with a Wooden Boring Bar 510
Discussion of the Previous Question:
Straightening Hardened Spindles.... Patent Interferences .... An Indexing Job....Cause of Tools Checking when Grinding....Concrete Floors ....An Electro Micrometer..... 513
Machining Flywheels in the Vertical Boring Mill..... 515
Remarkable Radial Drilling Machines... 517
New Tools and Machine Shop Appliances 519

Names of Machine Tools

There is more or less conflict regarding the names of some of the machine tools in common use that leads to considerable confusion at times, which we ought to be able to prevent.

Probably the worst sinner of the lot is the machine that is used more than any other, for drilling holes of one kind or another.

In common parlance any machine which drills holes is a "drill" whether it be upright, radial, horizontal, electric or pneumatic. But in reality the term drill can only be rightfully applied to the cutting tool itself, whether it be straight, twisted, hog nose, or any other shape. Yet we go on and say "drill" indiscriminately, meaning either the cutting tool or the machine which drives it, leaving it to either the rest of the text or to the imagination, to determine which is which.

The really dignified and proper thing to do is probably to say drilling machine in every case, but "radial drilling machine" gets stuck under the tongue and seems very awkward as compared with "radial drill."

With the milling, planing, slotting, shaping or gear-cutting machine we have adopted the simple custom of adding "er" to the name of the tool or operation as miller, planer, slotter, shaper, gear-cutter, gear-hobber, bolt cutter and thread miller or threader. These terms are in common use and no confusion is possible. Why not adopt the same plan with such other tools as now cause confusion such as the drilling and punching machines and call them "driller" and "puncher?" There would be no need to call the lathe a "turner" as there is no confusion regarding it, but it could be done if consistency was thought to be enough of a jewel to warrant it.

Vertical and horizontal boring machines also come in for a share of confusion, which can usually be avoided by the use of "mill" for vertical and "machine" for the horizontal types. Still the terms horizontal or vertical "borer" would settle the question in every case as with drills.

There is nothing new in these suggestions for they have been made in these columns at various times and by various men. Nor is there any desire to foist a "system" of names or symbols on an unsuspecting mechanical public. The single word "driller" would probably solve most of the trouble and do away with the confusion resulting from the use of "drill press," "vertical," and "upright drill" for the same machine. We already have about all we need for designation in other types of machines.

While it would seem odd at first to adopt the use of "driller," is it not logical and in line with the other machine-tool designations and is there a valid objection that does not apply to the use of "miller," "shaper" and others of that type?

Annual Meetings of National Metal Trades Association Branches

The eighth annual meeting of the Worcester Branch of the National Metal Trades Association was held on March 4, with President Chas. L. Hildreth as toastmaster.

The new officers are: Albert E. Newton, president; John W. Higgins, vice-president; Arthur N. Beaman, treasurer; C. W. Hobbs, George I. Alden, G. F. Brooks and A. W. Whitcomb, executive committee.

The meeting voted to support the new Trade School, and in favor of the Fitchburg half-time high school plan, while the Cincinnati continuation-school plan was also discussed.

Mr. Robert Wuest, the commissioner of the association, told of their history and objects, part of which follows:

"On January 1, 1910, the National Metal Trades Association comprised 758 persons, firms or corporations principally in the metal trades, employing practically 292,335 persons. Its membership is valuable because its members have acquired experience in dealing with the various aspects of the labor problem. The objects of the association I will briefly state as follows:

"First. To secure and preserve such conditions in the work-shops of our members as may fairly conserve both their interests and those of the employee.

"Second. To investigate and adjust differences between our members and their employees, which may be within the jurisdiction of our association under the provisions of our constitution.

"Third. To foster the betterment of the employees of our members by promoting improved methods of industrial education, by the adoption of coöperative and profit-sharing plans, and by inculcating the broad principle that capital and labor are interdependent and their interests mutual.

"Our association, formed August 21, 1899, was not the first organization of its kind in the United States, the National Founders' Association having paved the way for it. It was organized by members of the National Founders' Association, who, appreciating the value of the work accomplished by that association in their foundries, wished to extend a lik influence to other departments of their business."

Cincinnati Branch

The annual meeting and dinner of the Cincinnati Branch of the National Metal Trades Association was held at The Business Men's Club on March 3, and attended by about 100 members and visitors.

The report of the retiring president, John W. Neil, embodied a resumé of the work of the association during the past year, and helpful suggestions for the benefit of the officers to serve the ensuing year.

The following officers were elected to serve for the ensuing year: President, R. K. LeBlond; vice-president, E. H. Hargrave; treasurer, Henry Ritter; secretary, R. S. Alter.

An address by George K. Elliott, on "Iron Alloys" was of interest and showed an intimate knowledge of the subject. J. Howard Renshaw, the principal instructor of Cincinnati's continuation school, read a paper covering this school's successful work. Stanley E. Bowdle's address, "The Evolution of Machinery," was thoroughly enjoyed, as were a few minutes' talk by M. Cokely, of the Lima Locomotive and Machine Works, Lima, Ohio, on the line of the necessity for organization. The remarks of B. B. Quillen on the duty of employers toward their employees were apropos, and if heeded, would unquestionably achieve good results. C. Wood Walter, of the Cincinnati Milling Machine Company, brought the meeting to a close with a few well chosen remarks.

It was decided that the association would give an outing this year to all the employees of its members.

New York and New Jersey Branch

The annual meeting of the New York and New Jersey Branch was held on March 7, at Machinery Club, New York City. The meeting was preceded by a luncheon. The following officers were elected for the ensuing year: President, Stevenson Taylor; vice-president, Michael Fogarty; treasurer, L. A. Bevin.

Henry C. Hunter, counsel and secretary of the branch, submitted a report reviewing in detail the activities of the organization in the past year and pointing out that the branch has had a steady increase in membership, a number of automobile manufacturers having joined the association during the past year.

Robert Wuest, commissioner of the National Metal Trades Association, addressed the meeting.

PERSONALS

Items For This Column Are Solicited

D. G. Gautier, of D. G. Gautier Company and Philadelphia Steel and Forge Company, 50 Church street, New York, left for a European trip, March 2.

M. P. Fillingham, consulting engineer, 50 Church street, N. Y., has assumed charge of the eastern interests of the Fawcus Machine Company, of Pittsburg, Penn.

Benjamin Baker, formerly editor of *The Navy*, and Herbert M. Wilcox, chemical engineer, have joined the engineering staff of Walter B. Snow, publicity engineer, Boston, Mass.

Harry Hoover has become connected with the S. Obermayer Company, Cleveland, Ohio, and will look after the interests of that company in Buffalo and Dunkirk, N. Y. Mr. Hoover was formerly a foundry foreman.

George Ahrens, of Spokane, Wash., who has been president of the Moline Tool Company, Moline, Ill., for a number of years, not actively connected with the business, has assumed charge of the sales department of his company.

A. E. Williamson, for 10 years secretary and sales manager of the New Jersey Steel Company, Rahway, N. J., has resigned. He has incorporated the Bayonne Steel Castings Company, and will establish a foundry at Bayonne, N. J.

F. E. Bocorselski, who has been connected with the Baush Machine Tool Company for the past ten years, has resigned his position, effective April 1, to become assistant mechanical superintendent of the American Locomotive Company, with headquarters at Richmond, Va.

Samuel Hollander, for the past eight years in charge of the die-sinking department of the United Shoe Machinery Company, at the Beverly, Mass., factory, on March 1 entered the employ of the Union Drop Forge Company, of Providence, R. I., as mechanical superintendent.

Hermann Riecke, of the firm of Donauwerk Ernst Krause & Co., Vienna, who has been making connections with prominent American manufacturers for representation in Austria and the Balkan states, returns to Europe on March 17. Mr. Krause of the above concern was formerly manager of the Vienna branch of Schuchardt & Schütte.

New Tools *and* Machine Shop Appliances
Showing New Ideas *in* Machine Shop Equipment *that* make *it* possible *to* do better work at a reduced cost

A Combination Tool Holder

The halftones show a few of many applications of the Carr combination tool holder, made by The Henry G. Thompson & Son Company, New Haven, Conn.

This holder is arranged to accommodate a complete outfit of tools as used on the lathe or shaper. The body of the tool holder is held in place by the tool post and the tools are held on the side in dovetailed grooves, being clamped in position by means of collar screws. With this arrangement tools can be used on either side of the body and can work up close to either the chuck or the tailstock.

Tools can be removed, ground, and replaced without disturbing the position of the holder.

Fig. 1 shows a skeleton view of the tool holder, which is made in three sizes, taking steel from ¾ to 1½ inches wide, and from 3/32 to ⅜ inch thick. The two smaller sizes take tools 6 inches long, while the largest takes one 7 inches long.

Fig. 2 shows the holder in use as a turning tool. As will be seen, the high-speed steel cutter is supported and clamped its entire length. Fig. 3 shows the clamp and cutter.

Fig. 4 shows the complete boring outfit. The boring bars range in size from ¼ to 15/16 inch. They have a bearing the full length of the clamp. The set screw in the rear end of the bar for tightening the cutters in the larger sizes of bars fits the wrench used to tighten the collar screws on the holder.

Fig. 5 shows the threading tool. The formed cutter is made of tool steel ground to shape its entire length. It can be removed for grinding without disturbing its position relative to the thread being cut.

Fig. 6 shows a combination tool holder provided with a rocker adjustment for the tool. This was designed for use in lathes not provided with a rise and fall rest. By its use different hights of the tool may be obtained without the loss of side clearance.

ANY new or improved machine or shop appliance of interest to our readers will be illustrated and described in this department.

A full and more detailed description will be given—when of special interest and it appears here before being sent elsewhere.

ALL descriptions appear in all four editions of the paper—Weekly, Monthly, Weekly English and Weekly German.

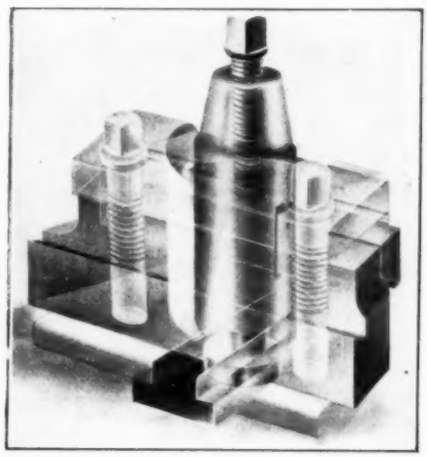


FIG. 1. SKELETON VIEW OF THE HOLDER

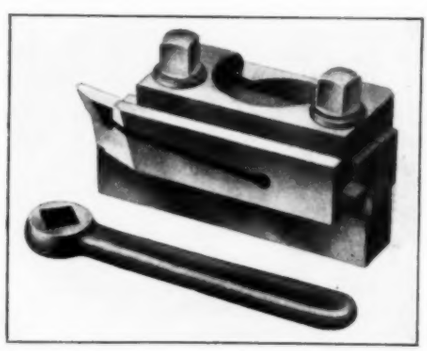


FIG. 2. USED AS A TURNING TOOL

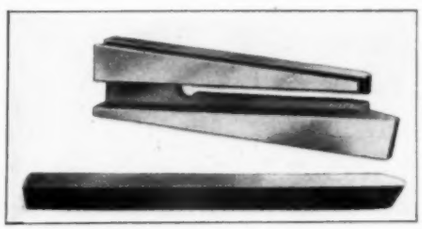


FIG. 3. CLAMP AND CUTTER

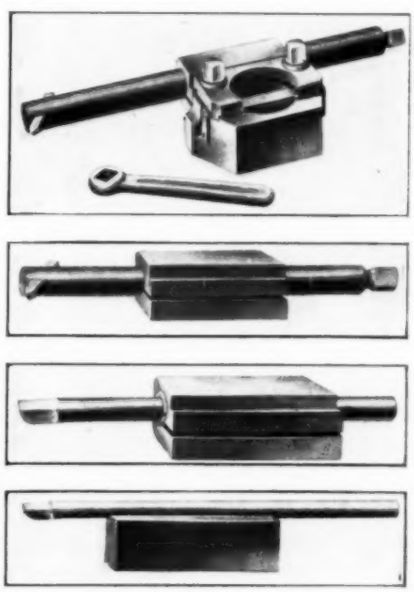
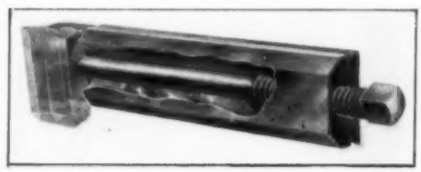


FIG. 4. COMPLETE BORING OUTFIT



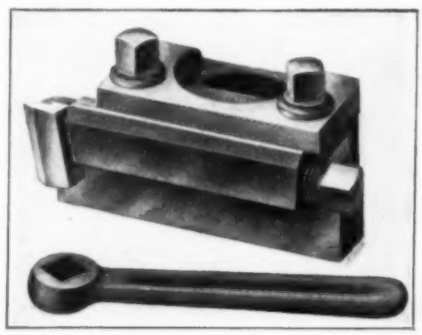


FIG. 5. AS A THREADING TOOL

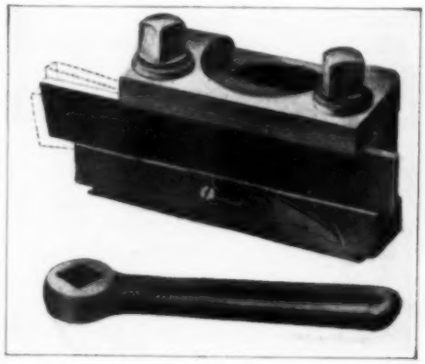
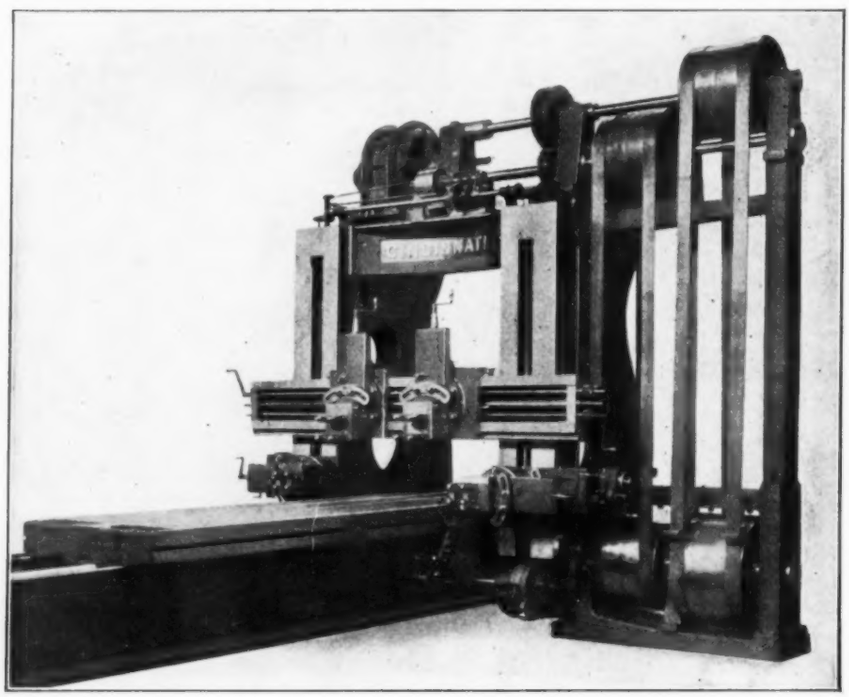


FIG. 6. TOOL HOLDER WITH ROCKER ADJUSTMENT

Extra Heavy Forge Type Planer

The illustration shows an extra heavy 56x56-inch planer of the forge type, built for severe duty and the side heads to do the principal work. It is built by The Cincinnati Planer Company, Cincinnati, Ohio.

The housings are extremely heavy, the face being 18 inches wide. The side heads have a narrow long bearing, so that they can be moved very easily. They have clamps on the inside and outside edge of the housing; the outer edge being furnished with a taper gib for adjustment. Owing to the extreme width of housing, the side head necessarily becomes very heavy and for that reason was fitted with rapid power traverse, which is operated by the little lever shown and all the gears are inclosed with a guard.



EXTRA HEAVY, 56x56-INCH FORGE TYPE PLANER

The rapid power traverse gets its power from the power elevating device used for raising and lowering the cross rail, and there is a tight and loose pulley on this device, so that when the belt is on the loose pulley it drives the two gears on the left side. This in turn drives the shaft with two bevel gears and keeps them operating all the time, so that the heads can be moved very readily by power when wanted. When it is desired to change the position of the rail, this belt is shoved over on the tight pulley, which merely revolves the shaft, then by manipulating the levers shown on the left side of the machine a small friction clutch is thrown in and will raise and lower the rail to suit.

The usual standard rail is equipped with taper gibs throughout, and is furnished with clamps on the inside edge of the housing, to eliminate any possible deflection, on account of its being clamped on the outer edge. The table is extra heavy, runs in wide V's, and is equipped with wide-face steel rack. The bed is of the four-wall type, and in addition there is a wall of metal running from the inside edge of the V to about two-thirds of the depth of the bed. The machine is equipped with steel gearing throughout and is driven by a 40-horsepower induction motor, of 850 revolutions, which was reduced to the proper countershaft speed by a rawhide gear.

As this machine was wanted with all open belts, a second shaft was placed on top with two gears, so that the cutting pulley and return pulley, on the top drive, operate in the opposite directions. The bearings carrying this top shaft are fitted with long bronze bushings and a ring-oiling device, so that there would be no danger of insufficient lubrication at the high speeds. To get sufficient power from this top drive, the machine was fitted with four 4-inch belts; two for the return and two for the cutting, which supplied the power over 30-inch pulleys on the machine. The loose pulleys were made with a special oil reservoir, so as to insure lubrication even though the operator would fail to oil it for some weeks.

As the side heads are to do most of the work, and naturally fall on top of the shifting mechanism, and to do away with any possibility of their doing any damage, a special guard covers the entire shifting mechanism, and yet does not interfere in any way with the setting of the dogs or operating the shifter by hand.

Flexible Adjustable Link Guard for Grinding Wheels

This guard, see Figs. 1 and 2, or hood, consists of a number of U-shaped links of pressed-steel plates, joined together

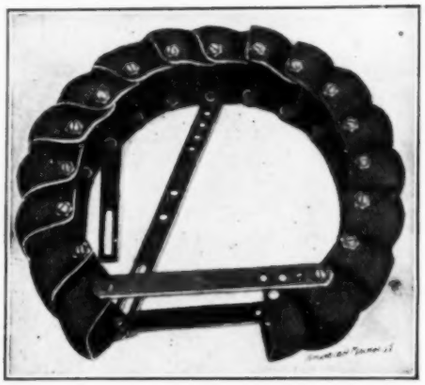


FIG. 1. GRINDING WHEEL LINK GUARD

with bolts and overlapping about a third of their length. This arrangement covers, not only the periphery, but a large part of the sides of the wheels. Such a method of inclosure has an advantage for grinding machines with dust exhaust, since the particles are caught by the links and carried along to trough-shaped end members, to which the suction pipe is connected.

As the wheel wears away, the hood can be adjusted in diameter by simply shifting the position of certain bolts and, if necessary, removing one or more links.

If the wheel breaks, its fragments tend to thrust the links struck by them outward, which pressure pulls other links inward against the wheel to act as a brake.

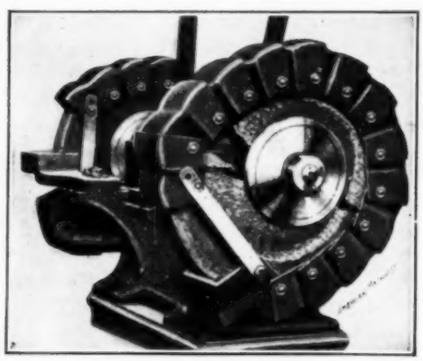


FIG. 2. LINK GUARD AROUND BROKEN WHEEL

An interesting test has been given to this guard by its manufacturers. In a long, narrow room, the walls of which were whitewashed smooth, one of the guards was placed on a powerful grinding machine over a Norton alundum wheel of 400 millimeters (15¾ inches) diameter and 75 millimeters (3 inches) thickness. The machine was run at 2200

revolutions per minute, corresponding to a circumferential velocity of about 46 meters per second (150 feet) as against the normal grinding speed of 25 meters (82 feet) per second. Suitable protection was afforded to the observer and to a workman whose duty it was to break the wheel with a long iron rod and a sledge hammer. Since the speed did not fracture the wheel, this manual method was resorted to, and it required 20 blows to accomplish the result. The noise of a dull thud followed, and then almost instantly the machine came to rest while the belt ran off the driving pulley. This trial gave the following results:

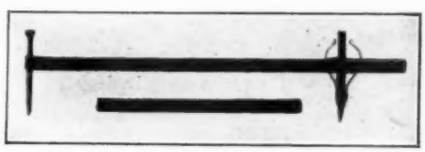
The grinding wheel was broken through in the middle, being split at one place by the last blow.

There was observed the above-mentioned braking action of the guard by its distortion under impact of the broken wheel.

The machine remained uninjured. Only one link of the hood was bent and a bolt sheared off. Neither on the floor nor on the freshly whitewashed walls were found traces of wheel fragments. The manufacturer of this appliance is the firm, Alfred H. Schütte, of Cologne, Germany.

The Knight Beam Compass

The instrument shown in the accompanying illustration is a very convenient form of beam compass for use either on the drawing board or in laying out work. The beam is of steel and is graduated in inches, which permits the ready adjustment of the pencil to an approximate setting, final adjustment being obtained by turning the needle point, which is ec-



THE KNIGHT BEAM COMPASS

centric with its holder. This holder is firmly clamped to the beam by a small clip operated by the nurled thumb nut which holds it firmly or allows vertical adjustment instantly.

The sliding holder or carrier is particularly convenient, being held firmly at any point by the spring shown and yet instantly movable by a slight movement of the fingers. This will hold either a pencil or drawing-pen as may be desired. The carrier can be used on either side of the beam, which makes the instrument particularly convenient for left-handed draftsmen, who can also reverse the needle point to bring all adjustments on the same side.

These instruments are usually supplied with two beams, one giving a 6- and the other a 12-inch radius, but by an ingenious way of reinforcing these beams with hardwood, any length up to 6 feet can be supplied, using the same section of beam so as to accommodate the same carrier and making the long beams remarkably light.

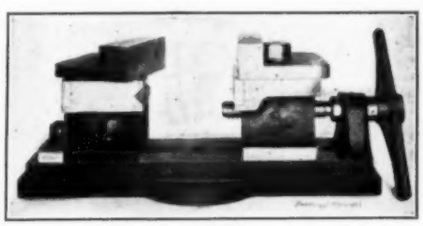
They also supply a plain steel eccentric center instead of the needle point and a steel scriber for the carrier for use in laying out metal work. This is known as the Knight beam compass and is made by the Sherwoode Tool and Instrument Company, Westtown, Penn.

A Drill Press, Shaper and Milling Machine Vise

The half-tone illustrates a new steel-faced vise that is a recent product of the Jackson Vise and Tool Company, 85 Beekman street, New York City.

The design is of rigid construction, and the large opening between the jaws, together with the four-sided rear revolving jaw, makes it adapted for a large range of work in size and shape without the use of bolts, straps, or clamps.

The front jaw has a travel of 3½ inches, it being operated with a steel screw and bronze nut and is held central with a tongue passing through the bed T-slot which is secured on the bottom side with a plate and screws, the



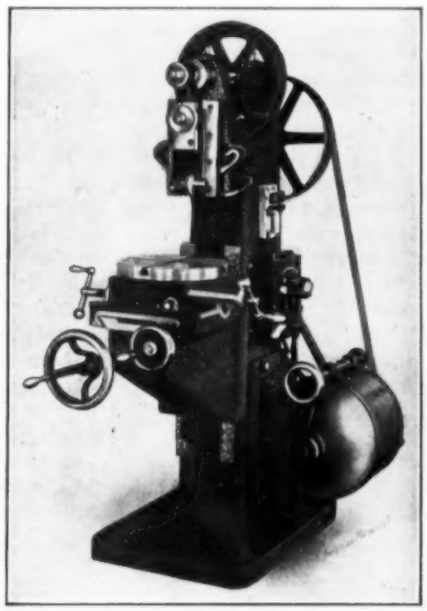
JACKSON "UTILITY" VISE

upper front part being faced with a removable steel facing. The revolving or rear jaw is made in the form of a hollow cube, the lower part of one side being left open to admit a wrench for operating the nut on the binding screw which passes through the T-slot in the bed and through the bottom of the jaw, the latter being drilled central revolves on the bolt and is fastened to the bed in any position. All sides of the jaw are machined, one having a steel face corresponding with front jaw, another side is faced full depth answering as an angle plate. This side also has a vertical V-groove extending full depth, which admits the centering and holding rounds, square, octagon and similar shaped material. A V-groove is also cut in the opposite side at right angle to the vertical groove, parallel with the bed for holding the above shaped material in the opposite direction.

The length of the bed is 19¼ inches, the vise is 6½ inches high, and opening between jaws is 8½ inches. Supplementary jaws can be supplied which make the range of work still wider.

A Motor Driven Die Slotter

The tool shown in the halftone is adapted for die work, small keyseating, both straight and taper, internal or external gear patterns, where draft is required, and all that class of slotting. The two right-angle motions and the ro-



A MOTOR-DRIVEN DIE SLOTTER

tary table provide for following any outline. The machine is run at from 29 to 87 strokes per minute. The length of the stroke has been fixed at 2½ in., which is ample for the class of work for which the machine is intended, and affords greater strength than an adjustable pin. The slide for the ram can be swiveled five degrees either way and set by a graduated index, thereby insuring the same draft to every part of the die. The tool block is adapted for holding tools in two positions. The weight of the machine is 1480 pounds. It is built by the Garvin Machine Company, New York.

The B & B Manufacturing Company, of 50 Church street, New York City, has placed on the market a new pickling solution for metals known as "scalene" and reports a demand for it from various industries.

If you have any plaster of paris casts to make from wooden patterns or models use tallow on the wooden pattern. It will not soak into and swell the model and will give a clean cast.

British Practice in Pipe Threads

By I. W. Chubb

With a view to the settlement of the doubt expressed as to current practice in Great Britain as regards threads on pipes, etc., I made inquiry of nearly a score of British manufacturers of tubes, fittings, etc., most of whom replied definitely. It may as well be stated at once that in very nearly every case the practice is to use the British Engineering Standards Committee threads, except obviously where otherwise specified by the customer. Thus firms like James Russell & Sons, Wendesbury, will be ready to thread to Whitworth, British or American standards, according to requirements. The current practice applies to ordinary threaded and coupled tubes for gas, water and steam.

In the past the Whitworth system was not quite generally adopted, although tubes up to 2 inches were generally threaded to that standard. As to large pipes, the only reply received in the inquiry, namely from T. Piggott & Co., Ltd., Birmingham, shows that the practice of this firm is to use Whitworth threads. The size of the pipe dealt with here is from 10 to 30 inches bore. As regards tapers, this firm mention that they have no standard, as customers are so diverse in their requirements. If not otherwise specified, the firm would use the American standard.

In the case of James Eadie & Sons, Rutherglen, near Glasgow, the threads on tubes have a taper of 1/32 inch to the inch or $\frac{3}{8}$ inch to the foot. The Engineering Standards Committee taper is thought in some instances to take away too much of the material. Again, their tubes are fitted with parallel threaded sockets, except in the case of oil line pipes, where the sockets are generally threaded taper to match the tubes.

Stewarts & Lloyds, Ltd., London, Birmingham and Glasgow, have an external taper on tubes of $\frac{3}{4}$ inch to the foot, the internal threads on couplers being straight. Taper-threaded couplers are not customary, although, of course, they can be supplied for special purposes.

This firm uses the taper on all pipe (not in couplings) for oil and gas lines or any pipe-carrying pressure. This applies to all pipes up to 36 inches in diameter.

New York Meeting of the A. S. M. E.

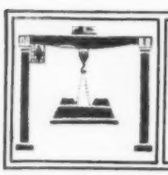
The next regular monthly meeting of the American Society of Mechanical Engineers will be held on April 12 in the Engineering Societies building at 8 p.m.

The meeting is to be conducted in conjunction with the American Institute of Electrical Engineers, and is to be given over to a discussion of electric driving in machine shops. Papers on the subject are to be presented by A. L. De Leeuw, of the Cincinnati Milling Machine Company; John Riddell, mechanical superintendent of the General Electric Company, and another by Charles Robbins of the Westinghouse Electric and Manufacturing Company.

Charles F. Aaron

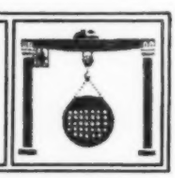
Charles F. Aaron, general sales manager of the New York Leather Belting Company, and past president of the American Supply and Machinery Manufacturers' Association, died at his home in Plainfield, N. J., on March 4.

Through his connection with the leather-belting industry Mr. Aaron was widely known in manufacturing circles of the country, and further became prominent through his active interest and work in conjunction with the American Supply and Machinery Manufacturers' Association, with which he was identified from its organization. Through this organization, in which he held an important position for many years, Mr. Aaron's efforts toward establishing a higher standard of manufacture in machinery and belting lines received widespread attention.



Increasing Shop Capacities

Where More Tools will be needed



Schimming & Eddins, Marlin, Tex., will erect machine shop and garage.

The Calgary (Alberta) Brew and Malt Company is building an addition.

The Little Rock (Ark.) Ice Company will increase the capacity of its plant.

Lanman & Kemp, 135 Water street, New York, will install a new power plant.

The American Lead Pencil Company, Hoboken, N. J., will erect a four-story addition.

The Connecticut River Power Company is rebuilding substation at Greendale, Mass.

The Noiseless Typewriter Company, Middletown, Conn., will build a new power house.

The Western Packing Company, of Chicago, Ill., is to erect a plant in Salt Lake City.

The Little Rock (Ark.) Brewing and Ice Company will build a new cold-storage house.

The Aeolian Organ and Music Company, Meriden, Conn., will enlarge its engine room.

The Saskatoon (Sask.) Milling Company will build a 500-barrel flour mill this spring.

The Bosch Magneto Company, of New York, will erect a plant in Brightwood, Mass.

Moore-Jones Machinery Company, St. Louis, Mo., will erect a new foundry to cost $25,000.

The Swift Automobile Company, Detroit, Mich., will erect a plant in Wyandotte, Mich.

Authentic news is solicited for this department. Real opportunities for the sale of machinery of any kind.

The Pullman Motor Car Company, of York, Penn., will erect a plant in Evansville, Ind.

The Eclipse Engine and Machine Company, of Keitchsburg, Ill., will move to Springfield, Ill.

The Fort Smith (Ark.) Light and Traction Company will extend its lines to Van Buren, Ark.

C. F. Jackson is erecting a garage and machine shop on South Hester street, Norwalk, Ohio.

The Prince Albert (Sask.) Lumber Company is considering the erection of a new mill.

The Canadian Northern Railroad has purchased land at Nutana, Sask., and will erect shops.

The Merced Falls Gas and Electric Company, Merced, Cal., is erecting a new substation.

The Western Picture Frame Company, Chicago, Ill., will erect a new factory to cost $60,000.

The city of Hastings, Neb., is to add new machinery to its lighting plant to cost about $25,000.

The city of Little Rock (Ark.) has voted to issue $55,000 bonds for a municipal lighting plant.

The Connecticut Telephone and Electric Company, Meriden, Conn., will increase its power plant.

The Hastings (Neb.) Iron and Foundry Company is to erect a new plant at a cost of $100,000.

The Warren Leather Goods Company, 84 Austin street, Worcester, Mass., is erecting a new factory.

The city of Hoboken, N. J., will build a new high school, also power plant. Cost, about $250,000.

Fire damaged the plant of the American Bridge Company, at Toledo, Ohio, to the extent of $100,000.

The Passaic (N. J.) Cotton Mill will build an addition to its factory and also enlarge its power plant.

The Clarkston (Wash.) Box Company will erect an addition to its plant doubling the present capacity.

The Russell Manufacturing Company, Middletown, Conn., will erect a power plant to operate its mills.

Fire in No. 2 machine shop of the Schofield-Holden Machine Company, Toronto, Ont., did $7000 damage.

The Massachusetts Cotton Mills, Lowell, Mass., will add new steam and water turbines to its power plant.

Chas. W. Young & Co., soap manufacturers, Philadelphia, Penn., will erect a $50,000 addition to their plant.

The Swinehart Tire and Rubber Company, Akron, Ohio, expects to build additions to its plant in the spring.

The Southern Anthracite Coal Company, Russellville, Ark., will install an electric plant for lighting and power.

The plant of the Brown-Talbot Machinery Company, Salem, Mass., was burned, causing a loss of about $10,000.

The plant of the M. Lantz & Sons Bolt Works, Pittsburg, Penn., was burned, causing a loss of about $150,000.

Foundations are in for the new machine shop for the Brown & Sharpe Manufacturing Company, Providence, R. I.

The Dahlstrom Metallic Door Company, Jamestown, Ohio, has commenced work on a new addition to its plant.

The Kinsey Manufacturing Company, Toledo, Ohio, manufacturing automobile parts, is to erect a three-story addition.

Permit has been secured by the Jones Scale Works, Binghamton, N. Y., for the erection of a foundry building.

An addition is to be built to the power house of the Stanley plant at Pittsfield, Mass., to cost about $60,000.

The Pepperell Manufacturing Company, of Biddeford, Me., contemplates building a power station on Factory Island.

The Oxford Linen Mills, North Brookfield, Mass., will erect two new factory buildings at a cost of about $500,000.

The Whiting & Davis Company, jewelers, Plainville, Mass., has awarded contract for the erection of an addition.

The plant of the Milwaukee Stamping Works, at West Allis, Wis., was destroyed by fire. Loss, about $150,000.

The Marblehead (Mass.) Gas and Electric Company is contemplating adding new steam turbines to its power plant.

The Toledo (Ohio) Rail and Light Company will erect a new power house, which, with equipment, is to cost $300,000.

Henry S. Ripple & Bro., Baltimore, Md., have had plans prepared for a new broom factory on Ridgely street, near West.

An auxiliary steam plant to cost $50,000, will be added to the plant of the Albany (Ga.) Power and Manufacturing Company.

The city of Jersey City, N. J., is to erect a new technical and industrial school and power plant. Cost, about $200,000.

Bell & Howell, Illinois street, Chicago, Ill., are enlarging their machine shop and contemplate adding some new equipment.

The Elm Refining Works Company, Stamford, Conn., refiners of gold and silver, has had plans drawn for a new plant.

Caleb L. McKee, Columbus, Ohio, has awarded contract for the erection of a garage and repair shop on North Fourth street.

The Louisville (Ky.) Lighting Company will expend $150,000 in improvements. New boilers and dynamos will be installed.

The U. S. Steel Corporation is said to be contemplating the erection of one of the biggest steel-car wheel plants in the world.

The Columbus (Ohio) Structural Steel Company has increased its capital stock to permit of additional machinery being installed.

The Phœnix Mutual Life Insurance Company, Hartford, Conn., is erecting an addition and will install its own power plant.

The F. & M. Schaefer Brewing Company is to erect a new bottling house at Park avenue and Fiftieth street, New York.

The National Hydraulic Tire Setter Company, of Keokuk, Iowa, will move to Springfield, Ill., where a new plant will be erected.

John G. Woodward & Co., Council Bluffs, Iowa, are considering plans for the erection of an addition which will double the capacity.

The Eau Claire Power Company will install new machinery in its power house at Calgary, Alberta, Canada, this summer or fall.

A splice bar mill to cost $300,000 will be added to the Edgar Thomson Works, of the United States Steel Corporation at Braddock, Penn.

The Chalmers Motor Company, Columbus, Ohio, is erecting a building to be used for the testing of motors and heat-treating of steels.

Plans for an addition to the Wilmington Malleable Iron Company, at South Wilmington, Del., to cost $50,000, have been completed.

The city electric light and power plant at Calgary, Alberta, Canada, will shortly increase its capacity and build a new power house.

The tinware plant of the H. L. Pague Manufacturing Company, Kansas City, Mo., was damaged by fire to the extent of about $30,000.

Daniel J. Kelly, 120 Railroad avenue, Elmira, N. Y., has bought site on which he will erect an uptodate tin shop to replace the present one.

The Southern Railway, it is said, will erect boiler shops at Spencer, N. C., to cost $85,000. W. H. Wells, Washington, D. C., engineer construction.

C. R. Carver Company, Philadelphia, Penn., manufacturing stamping presses, etc., has awarded contract for the construction of a new factory.

The De Tamble Motors Company, Anderson, Ind., will make extensive improvements. About $9000 worth of new machinery is to be installed.

The Nelson Valve Company, Chestnut Hill, Philadelphia, Penn., is contemplating the erection of additions to its plant to cost about $300,000.

The Renfrew Manufacturing Company has awarded contract for the erection of an addition to its power house at the Jacquard mill, Springfield, Mass.

The Philadelphia (Penn.) Warehousing and Cold Storage Company is planning to erect a new building which will almost double its present capacity.

It is reported the Southern Pacific Railway Company is planning to build a large steel plant in connection with its railroad shop in Sacramento.

The Ruliman-Ruliman Manufacturing Company, of Wathena, Kan., making washing machines, has bought site in St. Joseph, Mo., where it will locate.

The Hayden-Corbett Chain Company, Lorain avenue, Columbus, Ohio, will build an addition to its plant in addition to repairing damage done by a recent fire.

The Cincinnati (Ohio) Equipment Company is in the market for a 5-foot arm radial drill, complete with countershaft and wrenches. F. A. Peckham, sales manager.

T. E. Dowell, El Reno, Okla., is erecting a new two-story building where he will continue the manufacture of carriages and do a general blacksmithing business.

The Comstock-Wellman Bronze Company, Cleveland, Ohio, a new concern, is having plans prepared for the erection of a plant at Superior and East Sixtieth streets.

The White Steamer Automobile Company, Cleveland, Ohio, will erect a factory in Salt Lake City for the manufacture of automobile bodies and repair of all parts of machines.

The plant of the Springfield Facing Company, at Williamsett, Mass., was burned, causing a loss of about $50,000. The company manufactured foundry facings, etc.

The Locke Manufacturing Company, Robinson, Ill., has purchased site at Huntington, Ill., on which a plant for manufacturing iron, brass and aluminum articles will be erected.

The Arlington (N. J.) Stamping Company, which recently erected a new factory, is now erecting another building to be equipped with a full line of machinery for sheet-metal work.

Gustave Schoch, proprietor of Union Machine and Millwright Works, West Fifty-seventh street, New York, has purchased adjoining ground for the enlargement of its plant.

The Broadway Automobile Exchange has bought a factory building at Eleventh avenue and Fifty-Eighth street, which will be used for the manufacturing end of its automobile business.

The Pittsburg Plate Glass Company, advertising department, Frick building, Pittsburg, Penn., is in the market for a second-hand, slow-speed engine of 3000 horsepower about 75 revolutions.

The Globe Malleable Iron and Steel Company, Syracuse, N. Y., has incorporated with $700,000 capital to succeed the Globe Malleable Iron Company. A new forge will be erected near the present plant.

Work has begun on new car shops for the Great Northern Railway Company, at Delta, Wash. Complete cost will be $200,000, and the shops will be equipped to build a coach or sleeping car from the wheels up.

The plants of the Randolph Motor Car Company, of Chicago, Ill., and the MacClean Wheel Co., of Cleveland, are being moved to Flint, Mich. The concerns are under the control of the General Motors Company.

The Westinghouse Machine Company, East Pittsburg, Penn., is to add another department to build the Westinghouse marine steam turbines and Melville-Macalpine reduction gear for equipping United States Colliery No. 8.

The Continental Heater and Radiator Company, Manchester, Va., has purchased plant of Union Stove Works Company. Will improve same and install outfit for making castings in connection with stoves and heaters.

The Anderson Forge and Machine Company, Detroit, Mich., has bought site for its new plant and will build and equip what, it is said, will be the largest drop-forging plant in the country. Plant will include nine buildings.

The Atlas Machine Company, Waterbury, Conn., manufacturing power presses, etc., is building a new plant to take care of increasing business, which will be ready for occupancy about June 1. Capacity will be about doubled.

The Governor has signed a bill authorizing the trustees of public buildings to enter into a contract to the amount of $500,000 for the selection of a site and construction of a power plant for the Capitol and State Education building, at Albany, N. Y.

Stuart H. Clapp and James Addison, of Pittsfield, Mass., have acquired a controlling interest in the Berkshire Motor Car Company, of that place. The company will be reorganized with Mr. Addison as president. New machinery is to be bought and output increased.

The A. B. C. Castings Company, Cleveland, Ohio, recently incorporated, has commenced the erection of a foundry on Carnegie avenue, near East Sixty-Fifth street. Brass, bronze, copper and aluminum castings will be manufactured. Present address is the Arcade, Cleveland, Ohio.

John Neild, at present superintendent of the Grinnell Mill, New Bedford, Mass., will be general superintendent and agent of a new mill for the manufacture of fine cotton goods for which purpose company is being formed to have a capitalization of about $750,000.

Bids will be received at the Bureau of Navigation, Navy Department, Washington, D. C., until 12 o'clock noon, April 6, for a refrigerating and ice-making plant at the naval training station, Great Lakes, North Chicago, Ill. Proposals can be had of the Commandant at the station.

The Mt. Clemens (Mich.) Motor Car Manufacturing Company has filed articles of incorporation with $200,000 capital and has acquired site on which a plant will be erected. The company proposes to manufacture and deal in automobiles and parts thereof and conduct a general foundry and machine shop.

The Union Drop Forge Company has been organized with an authorized capital of $200,000. The company has secured the plant of the Bullard Wrench Company, of Providence, R. I., and will make all kinds of drop forgings. They are in the market for drop hammers and other associated machinery.

The New Departure Manufacturing Company, of Bristol, Conn., has acquired a controlling interest in the H. S. Houpt Automobile Company, of New York. Machine will be known as the Houpt-Rockwell car. The New Departure Company is now erecting a large addition to its plant to be used for general manufacturing purposes.

The Orson Automobile Company is a new concern capitalized at $10,000, incorporated under the laws of the State of New York, by well known capitalists, including Percy A. Rockefeller, H. O. Havemeyer, Frank A. Vanderlip, president of the National City Bank and others. Arrangements are being made for the establishment of a plant at Springfield, Mass.

The Wright Wrench Manufacturing Company, Canton, Ohio, has let contract and ground has been broken for a new factory necessitated by increasing business. The new factory, which will be ready for occupancy May 1, will have a floor space of over 13,000 square feet, equipped with modern machinery and will be able to turn out over 2000 wrenches a day.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open the following bids: March 22—Steam-drop hammer (schedule 2303); March 29—Erecting and installing coal- and ash-handling equipment (schedule 2324), No. 2 milling machine (schedule 2325); April 5—steel bolts and nuts, machine screws, wood screws (schedules 2308, 2310), ventilating fans (schedule 2309).

The new Lake Shore & Michigan Southern railway shops, at Elkhart, Ind., are to be among the best in the county when completed, and will involve an expenditure of upward of $3,000,000. It is expected that the buildings will be practically completed within a year and that the whole plant will be in operation within two years. Approximately two-thirds of the whole amount will be spent in machine tools and other equipment.

The Hub Machine, Welding and Contracting Company, Philadelphia, Penn., has been incorporated with $100,000 capital to take over the Hub Machine and Tool Company, and the Mechanical Manufacturing Company. A new building has been leased in which the company will manufacture saw tables and other tools, do electric welding and general machine work. It is said a number of additional tools and equipment will be needed.

NEW INCORPORATIONS

Hygenia Brush Company, Worcester, Mass. Manufacture patent brushes. Capital, $99,000. F. W. Mark, president.

Ohio Metallic Specialty Company, Columbus, Ohio. Capital, $50,000. Incorporators, Peter Ebner, C. W. Groff, G. W. Cory, etc.

Superior Drop Forge and Manufacturing Company, Cleveland, Ohio. Capital, $150,000. Incorporators, W. H. Lucas, F. V. Enrich, P. C. Bredel, etc.

W. H. Miner Company, Chicago, Ill. Manufacture tools and machinery. Capital, $100,000. Incorporators, W. H. Miner, N. M. Goldsmith, G. I. Haight.

Russell Generator Company, Jersey City, N. J. Manufacture gas generators. Capital, $100,000. Incorporators, E. J. Reilly, P. McGann, John Callery.

Matador Tire and Vulcanizing Company, Chicago, Ill. Manufacture tires and accessories. Capital, $60,000. Incorporators, L. C. Smith, J. R. Findlater.

Elgin Separator Sales Company, Newark, N. J. Manufacture cream separators, etc. Capital, $250,000. Incorporators, C. C. Morrow, Orlin Kanouse, A. B. Johnson.

Kattell Manufacturing Company, Binghamton, N. Y. Manufacture razors, cutlery, hardware. Capital, $50,000. Incorporators, S. M. Kattell, F. B. Kattell, F. L. Wooster.

Baldwin & Covert, Ridgewood, N. J. Automobile garage. Capital, $50,000. Incorporators, M. D. Baldwin, Ridgewood; O. S. Baldwin, Brooklyn, N. Y.; L. Covert, New York City.

Check Automatic Switch-Throw Company, Little Rock, Ark. Manufacture switches and appliances. Capital, $100,000. Incorporators, H. M. Check, Lewis Ottenheimer, Chas. Jacobson.

A. E. Bennett Specialty Manufacturing Company, Buffalo, N. Y. Manufacture and deal in vending machines. Capital, $50,000. Incorporators, A. E. Bennett, W. A. Short, W. F. Hurd.

Lund Engineering and Construction Company, Jersey City, N. J. Machinists, mechanical engineers, etc. Capital, $500,000. Incorporators, H. O. Couglan, L. H. Gunther, John H. Turner.

Chester Automobile Tire Company, Camden, N. J. Capital, $500,000. Manufacture tires and wheels for automobiles, bicycles, etc. Incorporators, J. F. Swain, G. M. Bryson, Wynn Armstrong.

Lawson Motor Car and Garage Company, Peekskill, N. Y. Manufacture and deal in all kinds of automobiles and motors. Capital, $75,000. Incorporators, W. Lawson, A. Lawson, W. S. Lawson.

Lilly Engine Company, Jamestown, N. Y. Manufacture automobiles, motors, etc. Capital, $150,000. Incorporators, C. H. Henderson, J. R. Graves, Corry, Penn.; Geo. H. Monroe, Jamestown, N. Y.

D. B. Drake Woodworking Company, Bayonne, N. J. Manufacture store fixtures and interior woodwork. Capital, $50,000. Incorporators, G. Kraus, J. Frost, Bayonne; C. J. Drake, New York.

Tubular Construction Company, Jersey City, N. J. Manufacture machinery, etc. Capital, $100,000. Incorporators, C. F. Pope, New York; L. Atwood, Farmington Falls, Me.; C. N. King, Jersey City.

The Fenn Machine and Needle Manufacturing Company, Hartford, Conn. Manufacture knitting needles and machinery. Capital, $1,000,000. Incorporators, A. G. Fenn, James H. W. Harris, S. J. Griffin.

New York Electric Tool Company, New York. Manufacture and deal in electrical devices and appliances. Capital, $50,000. Incorporators, M. S. Carver, A. F. Carver, 142 West Forty-Second street, etc.

Hub Motor Company of America, New York. Manufacture and sell motors, engines and machinery of all kinds. Capital, $1,000,000. Incorporators, C. A. Spofford, New York; P. S. Smith, C. Berg, Philadelphia.

Niagara Metalware Manufacturing Company, Buffalo, N. Y. Manufacture wood, metal and other specialties. Capital, $40,000. Incorporators, H. R. Schmiedendorf, W. R. Daniels, Buffalo; A. A. Schaml, Niagara Falls.

Hudson County Automobile Company, Guttenberg, N. J. Manufacture automobiles, motor boats, automobile machinery, etc. Capital, $10,000. Incorporators, S. J. Leback, 141 Broadway, New York; G. W. Korn, 170 Broadway, New York, etc.

Federal Motor Company, Buffalo, N. Y. Manufacture machinery to generate gas or electricity, vehicles of all kinds, gasolene motors, etc. Capital, $100,000. Incorporators, H. A. Dann, Lancaster, N. Y.; W. C. Barker, T. C. Koons, Buffalo.

Engineering Electric Manufacturing Company, New York. Electrical work of all kinds, general contracting and manufacturing business. Capital, $100,000. Incorporators, W. G. Hooke, 100 Hamilton place; L. L. Ferguson, 170 Broadway, etc.

New Taxicab and Auto Company, New York. Manufacture, deal in and repair motor vehicles, etc. Capital, $25,000. Incorporators, Geo. H. Reaney, 133 West Ninety-Second street, Fred J. Manning, 35 West Ninety-Seventh street, New York, etc.

BUSINESS ITEMS

Prentiss Vise Company, of New York City, will soon move into its new quarters at 106-110 Lafayette street.

The Page-Storms Drop Forge Company, Chicopee, Mass., has recently installed several new steam drop hammers.

A. P. Witteman Company, Philadelphia, Penn., with works at Chester, Penn., has taken over the equipment of the Portsmouth Forge Company, Portsmouth, N. H.

A complete equipment of rivet-rod furnaces and rivet-heating furnaces has just been installed at the Lackawanna Bridge Company's new plant in Buffalo, N. Y., by Tate, Jones & Co., Incorporated, Pittsburg, Penn.

The Gannett Electrical Company, Providence, R. I., manufacturer of the Clark automatic switchboard telephone systems for fac-

tory use, has moved to a larger plant at 55 Pine street, that city, which will furnish it much larger shop facilities and enable it to keep up with the increasing demand for its telephones.

TRADE CATALOGS

O. S. Walker & Co., Worcester, Mass. Catalog describing magnetic chucks. Illustrated, 48 pages, 6x9 inches, paper.

Rowbottom Machine Company, Waterville, Conn. Circular illustrating and describing universal cam-milling machine.

The Emerson Electric Manufacturing Company, St. Louis, Mo. Catalog of alternating-current fans. Illustrated, 72 pages, 5½x7½ inches, paper.

Oxy-Carbi Company, New Haven, Conn. Catalog describing oxy-acetylene cutting and welding apparatus. Illustrated, 18 pages, 6x9 inches, paper.

The Henry G. Thompson Son Company, New Haven, Conn. Catalog No. 2, describing Carr tool holders. Illustrated, 28 pages, 3½x6½ inches, paper.

FORTHCOMING MEETINGS

Southern Supply and Machinery Dealers' Association and American Supply and Machinery Manufacturers' Association, joint convention, Jacksonville, Fla., April 5, 6 and 7, 1910, Hotel Seminole. F. D. Mitchell, secretary, 309 Broadway, New York City.

National Metal Trades Association, annual convention, Hotel Astor, New York City, April 13-14, 1910. Robert Wuest, Commissioner, New England building, Cleveland, Ohio.

International Railway General Foremen's Association, annual convention, May 3-7, Grand hotel, Cincinnati, Ohio. L. H. Bryan, secretary, Two Harbors, Minn.

American Society of Mechanical Engineers, spring meetings, Atlantic City, N. J., May 31-June 3. Calvin W. Rice, secretary, 29 West Thirty-ninth street, New York City.

American Foundrymen's Association and American Brass Founders Association; joint convention, June 7-8-9, Detroit, Mich.; headquarters, Hotel Pontchartrain. Richard Moldenke, secretary, Watchung, N. J.

National Gas and Gasolene Engine Trades Association. Semi-annual convention, Cincinnati, Ohio, June 13-16, 1910; headquarters, Hotel Sinton. Albert Stritmatter, secretary, Cincinnati, Ohio.

Master Car Builders Association; annual meeting June 15-17, Atlantic City, N. J. J. W. Taylor, secretary, Old Colony building, Chicago, Ill.

American Railway Master Mechanics Association, June 20-22, Atlantic City, N. J. J. W. Taylor, secretary, Old Colony building, Chicago, Ill.

Joint meeting of American Society of Mechanical Engineers and Institution of Mechanical Engineers, Birmingham, England, July 26-29, 1910.

American Society of Mechanical Engineers; monthly meeting second Tuesday. Calvin W. Rice, secretary, 29 West Thirty-ninth street, New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's hotel. D. F. P. Clark, secretary, 309 Milk street, Boston, Mass.

Providence Association of Mechanical Engineers. Monthly meeting fourth Tuesday each month. E. C. Bliss, president, 91 Sabine street, Providence, R. I.

New England Foundrymen's Association; regular meeting second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania; monthly meeting third Tuesday. Elmer K. Hiles, secretary, Fulton building, Pittsburg, Penn.

Superintendents' and Foremen's Club of Cleveland; monthly meeting third Saturday, Phil. Frankel, secretary, 310 New England building, Cleveland, O.

Western Society of Engineers, Chicago, Ill. Regular meeting first Wednesday evening of each month, excepting July and August. Secretary, J. H. Warder, 1735 Monadnock block, Chicago, Ill.

WANT ADVERTISEMENTS

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendations or other papers of value should not be inclosed to unknown correspondents. Only bona-fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Caliper catalog free. E. G. Smith, Columbia, Pa.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Special machinery accurately built. Screw machine or turret lathe work solicited. Robert J. Emory & Co., Newark, N. J.

Light and medium weight machinery and duplicate parts built to order; tools, jigs, etc. MacCordy Mfg. Co., Amsterdam, N. Y.

Wanted—Heavy screw cutting engine lathe about 54" or 60" swing, 16 ft. or 18 ft. bed; must be in good condition and cheap. Box 320, AMERICAN MACHINIST.

German-American graduate engineer, desires to represent firm at the coming Berlin exhibition for machinery; American and German references. Box 292, AMER. MACH.

Mechanical engineer, college graduate, A-1 references, wishes to represent American firms in Europe; parties interested will please write to Box 319, AMERICAN MACHINIST.

Mechanical engineer desires to represent some reliable manufacturing concern, in introducing mechanical specialties throughout Indiana, Michigan and Ohio. Box 317, AM. M.

I wish to change my location to small town; will furnish excellent exclusive line of machines to manufacturer desiring to extend his field. "Superintendent," Box 271, AM. M.

Consulting mechanical engineer, with general practice, wishes catalogs and price lists of machinery and fixtures that might be useful in his work. J. Franklin Cary, 26 East Van Buren St., Chicago.

Wanted—Machine work for lathes, shapers, milling machines, screw machines, etc., and would be pleased to figure on your dies, jigs, models, sheet metal stampings and auto parts. The F. G. Marbach Co., Medina, Ohio.

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMERICAN MACHINIST.

The Garvin Machine Company, Spring and Varick Sts., New York, irrespective of catalogs now in use are installing a library in their drawing room. It might be of benefit to manufacturers of goods in which they are interested to send them catalogs marked "Library Department."

Wanted to Buy—Radial drill, 5-foot arms, full universal tilting table, speed regulator, stating number of changes of speed; machine to be complete with countershaft and necessary wrenches; state lowest price, location, age and actual present condition. The Cincinnati Equipment Co., Cincinnati, Ohio.

We wish to buy a second-hand slow-speed engine of about 3000 horsepower and about 75 revolutions; we prefer a vertical engine, but will consider a horizontal; also our preference would be to have one capable of carrying reasonable overload; we want the privilege of examination. Please write, stating price, to Plttsburgh Plate Glass Company, Advertising Department, Frick building, Pittsburg, Penn.

Will lease to responsible party, 75 to 100 ton, strictly modern foundry, fully equipped with the very best crane and general foundry equipment; located Allentown, Penn. This foundry adjoining modern machine shop where machining of castings can be arranged for at reasonable prices. The owners will supply foundry with a large amount of work on competitive prices. Address all communications, R. W. Traylor, 30 Church St., New York City.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CALIFORNIA

Wanted—First-class man, well experienced in manufacturing pneumatic tools; good chance for the right man. Box 314, AM. MA.

CONNECTICUT

Wanted—Diemakers. Apply to Robert N. Bassett Co., Derby, Conn.

Wanted—One or two first-class eyelet toolmakers, also one with good executive ability, with view of advancing to foremanship. Answer, stating age, nationality and experience. Correspondence will be treated strictly confidential. Box 289, AMERICAN MACHINIST.

ILLINOIS

Wanted—Assistant chief engineer of power stations totaling forty thousand horsepower, and comprising gas engines, turbines and reciprocating engines; those having experience in a similar capacity and who understand handling of men and equipment apply, stating experience, present occupation and pay. Address C-47, Trade Bldg., Chicago, Ill.

INDIANA

Wanted—Foreman, one who has had experience in building machine tools; a bright future for the right man. Box 146, AM. MA.

Wanted—Machinists, we are continually increasing our force; we invite applications from lathe and floor hands, those who desire a steady position. Apply at Wood Turret Machine Co., Brazil, Ind.

MASSACHUSETTS

Wanted—An energetic young man, technical education preferred, to introduce a special brand of steel for machine tool parts in New England territory; permanent position at good salary; applicant should have good general knowledge of qualities required in various machine tool parts; no application considered except from parties of highest standard of character and ability; all applications treated in strictest confidence. Address with full particulars, P. O. Box 1188, Boston, Mass.

We are increasing our force and invite applications from experienced iron and brass moulders, core makers, chippers, pattern makers, draftsmen, production men, machine tool operators (all kinds), brass finishers, polishers, layout men, bench hands, erectors, etc. Heavy and light engine and pump manufacture; works handy to Boston and best evening schools; no labor trouble, and applicants are notified as soon as positions are open; applicants should state age, height, weight and experience in detail. Address Employment Division, Blake & Knowles Steam Pump Works, East Cambridge, Mass.

MICHIGAN

Wanted—Toolmakers, die sinkers, lathe hands, machinists and automatic screw machine operators; A-1 men only. Buick Motor Co., Flint, Mich.

Wanted—Assistant superintendent for automobile factory; must be a hustler and able to show from past record that he can produce results, capable of handling men and have executive ability; age 28 to 35; in answering give references, experience and salary expected. Box 287, AMERICAN MACHINIST.

Wanted—By a concern manufacturing Corliss and slide-valve engines and other machinery, a thoroughly competent machinist, familiar with the efficient operation of large and small machine tools and the design of jigs, special tools, etc., to act as assistant to the foreman in machine shop employing 75 men, for the purpose of instructing employees as to best methods of doing work and to devise tools, jigs, etc., for attaining the most economical production. Write fully, giving experience and salary expected. "Expert," AMERICAN MACHINIST.

NEBRASKA

Wanted—In city of Middle West, first-class machinist to operate upright style of mill roll corrugating machine; must have had experience in this class of work and be familiar with the milling industry. Box 254, AM. MA.

NEW JERSEY

Wanted—Draftsmen familiar with machine tool work; give references and salary expected. Box 215, AMERICAN MACHINIST.

Wanted—Draftsmen familiar with heavy turret lathe work; give references and salary expected. Box 216, AMERICAN MACHINIST.

Men wanted to become mechanical draftsmen; pay $35 to $75 weekly; complete course at your home 4 months. Box 433, Newark, N. J.

Wanted—A-1 general foreman, competent to get maximum production in all departments of general machine shop; capable of taking charge of entire plant; give reference, age and salary expected. Box 286, AM. MA.

Wanted—Machinists; steady work for good milling, boring, lathe and floor hands; also tool and die makers; call in person if possible; cheap rents and pleasant surroundings. Ferracute Machine Company, Bridgeton, N. J. (40 miles south of Philadelphia).

Wanted—Foreman for machine shop in high speed and marine gas engine plant; must have a thorough knowledge of machine processes and know the best types of machines, suited for his work and know how to handle jigs, tools and fixtures and have ability to handle men and to get the best from them. Address, giving experience in full, age, nationality, references and salary expected. Box 316, AMERICAN MACHINIST.

NEW YORK

Wanted—First-class jig and fixture draftsman. Apply Mergenthaler Linotype Company, 24 Ryerson St., Brooklyn, N. Y.

Wanted—A few draftsmen familiar with design of tools, electrical apparatus and switchboard layouts. Apply General Electric Company, Engineer in Charge, Drafting Dept., Schenectady, N. Y.

Wanted—Foundry foreman, experienced in gray iron bench work and machine molding on agricultural work; state age, previous experience and salary expected; give references. Address "L. D.," AMERICAN MACHINIST.

Wanted—Master mechanic, capable of taking charge of jig and die designing, millwrighting, and general plant repair work; state age, previous experience and salary desired; give references. Address "F. R.," AM. M.

Machinists Wanted—We are enlarging our factory and invite applications from machinists; lathe, drill press and milling machine men, Jones & Lamson operators and toolmakers; in making application, state fully qualifications and wages wanted. The Kirkham Motor Mfg. Co., Bath, N. Y.

Wanted—First-class toolmakers, experienced on jig, fixture, watch tool and precision work. Apply Mergenthaler Linotype Co., 24 Ryerson St., Brooklyn, N. Y.

Wanted—We are constantly increasing our force and invite applications from the following: Machinists, lathe hands, screw machine hands, grinder hands, milling machine hands, motor assemblers, toolmakers, sheet metal die men; we run a nine-hour shop, have desirable surroundings, and offer steady position to desirable characters. Address Superintendent, Maxwell-Briscoe Motor Co., Tarrytown, N. Y.

A live first-class traveling salesman for New York and eastern territory to sell Allen's tool steels; reliable, resourceful and energetic man with good practical knowledge of and experienced in handling high-grade steels; in sending applications kindly state fully and in detail all your qualifications, your specialties, if you have any, whom you have worked for, as well as whom you are working for now, salary expected, references and any other information which will help us in judging the merits of your application; these details will be held in the strictest confidence; opportunities are limited only by employee's ability. Apply by letter only to, Mr. J. C. Ward, Director, Edgar Allen & Co., Ltd., 282 Pearl St., New York City.

OHIO

Screw machine operator as working foreman to produce maximum and satisfactory output from eight to ten automatic and hand screw machines, standard make; must come well recommended and competent to handle workmen to advantage; state age, experience and wages desired. Box 306, AMER. MACH.

Wanted—First-class machinists, toolmakers die sinkers, lathe, planer, drill press, screw machine, boring and milling machine operators, wood patternmakers, brass molders, polishers, buffers, finishers, spinners, millwrights, hammermen and blacksmiths who are seeking positions or desirous of improving on those which they have, to register their names and addresses with the free Employment Department of the National Metal Trades Association. Address Commissioner's Office, 605 New England Bldg., Cleveland, O.

PENNSYLVANIA

Wanted—Diemaker for small pressed-steel stampings; steady work, good pay to right party. McDowell Manufacturing Co., 541 Wood St., Pittsburg, Penn.

Wanted—Reliable, energetic traveling salesman, one familiar with paper mill machinery preferred; state age, experience and salary expected. Box 318, AMERICAN MACHINIST.

TENNESSEE

Wanted—One (1) experienced planer hand and one (1) experienced assembler, for slide valve engine work. Box 253, AMER. MACH.

WISCONSIN

Draftsman—Wanted, a draftsman familiar with tool and jig work. Address Fairbanks-Morse Mfg. Co., Beloit, Wis.

We are enlarging our works, and are in need of mechanics, especially toolmakers, lathe hands, boring mill and boring-bar hands, and Jones & Lamson screw machine hands. Fairbanks-Morse Mfg. Co., Beloit, Wis.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Chance for advancement wanted; am 26 years old, understand the making of metal patterns, machine and tool room work; have had experience of setting up of die presses and hand screw machines; can harden and temper ordinary work; some foundry experience; would also like some drafting. Box 312, AMERICAN MACHINIST.

Wanted—Situation as general superintendent by a first-class mechanical expert, in brass or iron, hardware or specialty line; well up on modern machine work and finishing, designing of jigs and tools; original labor-saving devices; have good executive ability; age 40; American; would not consider making a change for less than $2000 per year. Box 313, AMERICAN MACHINIST.

ILLINOIS

A successful superintendent of the Otis Elevator Company is seeking change of position. Address Box 230, AMER. MACHINIST.

Position as superintendent; have a thorough knowledge of best machine shop and foundry practice; can get maximum production from men and equipment; accustomed to large works; good reasons for changing. Box 295, AMERICAN MACHINIST.

INDIANA

Mechanical engineer, technical graduate, 8 years' practical experience in shop engineering and manufacturing, desires a change; best of references. Box 323, AMER. MACH.

MASSACHUSETTS

Situation by a thorough mechanic, inventor, tool and die maker, machine builder and economizer who has filled the position as designer foreman and superintendent; a position similar. Box 326, AMERICAN MACHINIST.

NEW JERSEY

Tool designer, 4 years as tool designer and 8 years as toolmaker; experienced in standardizing tool parts and reduce tool labor to a minimum. Box 321, AMERICAN MACHINIST.

NEW YORK

Experimental machinist, extensive practical experience on engineers and inventors' productions; references A-1. Box 328, AM. MA.

Wanted—Position as foreman or assistant by first-class man on Potter & Johnston automatic and automatic screw machines. Box 309, AMERICAN MACHINIST.

Experienced foreman, middle aged, modern ideas, now employed, desires change; engineering work, dynamos and steam pumps; A-1 hustler; can handle large force with ability. Box 291, AMERICAN MACHINIST.

Mechanical engineer, experienced in heavy structural work, steel and concrete; power plant equipment; machine designing; six years charge of drafting department; wish to locate South or West. Box 325, AM. MA.

Master mechanic, with large paper goods manufacturing company, desires change; 20 years' experience designing, inventing and building, printing, box making, paper handling and automatic machinery. Box 322, AMERICAN MACHINIST.

Toolmaker, German, all-around machinist, 16 years' experience on experimental work, tools, dies and small automatic machinery, inventive ability and quick at grasping ideas, wants to change position; will go to any State. Box 310, AMERICAN MACHINIST.

Wanted—By skilled mechanic, well up in modern tool room and machine shop practice, a position as general foreman, or assistant superintendent; have had about 22 years' experience; can furnish best of references; location East. Box 290, AMERICAN MACHINIST.

A strictly high-class, thoroughly practical mechanical engineer desires a position as confidential experimenter; make own drawings, patterns, models, etc.; familiar with patents and can write patent specifications; mechanical recording devices a specialty. Box 327, AMERICAN MACHINIST.

Machinist, toolmaker, diemaker, young man, high-grade mechanic, high degree inventive ability, developes, improves inventions, good technical education, labor-saving devices, willing to meet difficult propositions, foremanship experience, wants good paying position. L. M., 55 West 116th St., New York City.

Executive position paying minimum salary of $5000 first year; qualifications, American, 39 years old, 5 feet 8 inches tall, 158 pounds; education, high school, business college; technical institute; mechanical expert, mechanical and electrical engineering, practical and experienced in all departments; business accounting and management; 16 years' executive experience; give full particulars at first writing. Box 329, AMERICAN MACHINIST.

Tools and equipment; first-class, practical mechanic is open for position with parties who desire to manufacture with most uptodate tools, etc., for the rapid and economical production of such work as steam and water specialties, valves, fittings, small engine and similar work; age 39, with 20 years' experience in modern plants; accustomed to control help to best advantage; will give references required. Box 330, AMERICAN MACHINIST.

OHIO

Designer and draftsman desires change; go anywhere. Box 298, AMERICAN MACHINIST.

Machine and tool designer, technical graduate, 7 years' experience in machine tools, special machinery tools, jigs and fixtures for light high-grade machinery, wishes to make a change. Box 296, AMERICAN MACHINIST.

Production engineer, planning, time study and rate setting, solicits correspondence; now engaged in machine tool manufacture; technical education and extensive experience in other lines. Box 324, AMERICAN MACHINIST.

Mechanical engineer, technical graduate; broad practical knowledge of engineering; good systematizer; especially able as a producer; several years' experience in engineering work, having had charge of large engineering departments, desires position with first-class firm as chief engineer, or similar position. Box 315, AMERICAN MACHINIST.

PENNSYLVANIA

Gas engine draftsman wants responsible position; many years' experience in all sizes of engines. Box 299, AMERICAN MACHINIST.

Designing engineer, graduate, age 32, exceptional experience designing and developing new automatic, special machinery, fine apparatus, adding machines, typewriters; inventive and practical; only responsible position considered. Box 280, AMERICAN MACHINIST.

Position wanted as assistant manager or superintendent by uptodate mechanic in the manufacture of small sheet metal and wire novelties as buckles, suspender trimmings, corset trimmings, pins, safety pins, hooks and eyes, paper fasteners, also duplicate parts as clock movements, typewriter and adding machines, all kinds of stamped work; only first-class position considered; at present holding position as superintendent. Box 229, AMERICAN MACHINIST.

FOR SALE

For Sale—200-horsepower Harris-Corliss engine in perfect condition; the reason for selling mill business discontinued. The Elm City Lumber Co., New Haven, Conn.

For Sale—Vending machine and novelty business, comprising patents and complete manufacturing equipment, dies, presses, screw machine, etc. Box 311, AMER. MACHINIST.

A new and most valuable patented tool for machinists or mechanics; will sell patent cheap; something absolutely new and extremely useful. Box 198, AMER. MACHINIST.

For Sale—One Nash gas engine, 20 horsepower, two cylinder, for electric lighting, pumping or power; one Beaman & Smith horizontal boring mill; table 25 inches wide, 36 inches long; will bore 12 inches diameter, 24 inches long, and face 20 inches diameter; one 300 light J. B. Colt Co. acetylene gas apparatus. The above machines are in excellent condition, having been very little used. For further particulars and prices apply to Rider-Ericsson Engine Co., 35 Warren St., New York.

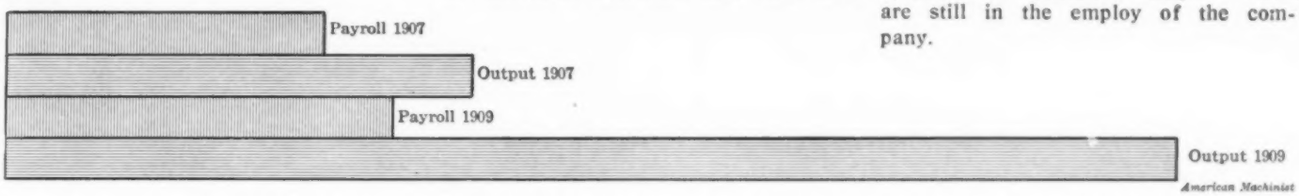
Stock for Sale—Controlling interest in the Fishkill Landing Machine Company, builders of the "Fishkill Corliss" engine, machinery, castings, etc. Business long established, having an enviable reputation for the high character of its work. The works are located on the east bank of the Hudson river, fifty-eight miles above New York City, and about three minutes' walk north from the Fishkill Landing station of the New York Central Railroad, a track of which runs through the works. Having several other railroad connections, in addition to their extensive dock frontage, afford unsurpassed facilities for receiving and shipping by rail or water. This is one of the finest properties in New York State, and as a large part of it is not required for the present business, it is very valuable for any manufacturing purpose. For particulars, address W. F. Sage, Fishkill-on-Hudson, N. Y.

Effect of Reorganization in the Canadian Rifle Factory

Ratio of Payroll to Output, 1907 1:1.33 Increased 1909 to 1:3

By Frederick A. Waldron *

The diagram shows graphically the changes in the output of the factory in a period of 20 months, and is a very complete example of what can be accomplished in the majority of factories by the continuous use of the common-sense methods regularly and systematically applied.



GRAPHICAL STATEMENTS OF PAYROLL AND OUTPUT, BEFORE AND AFTER REORGANIZATION

Ratio: 1909 payroll to 1907 payroll, 1.091:1; ratio of 1907 payroll to output, 1:1.33.
Ratio: 1909 output to 1907 output, 3.33:1; ratio of 1909 payroll to output, 1:3.
Reorganization work started in plant, March, 1908.
No new buildings were put up or additions to plant made excepting one lathe costing $600 and a few polishing jacks
Maintenance charges for labor, including new tools, repairs to plant, machinery, clerical force and factory salaries are included in payroll in both cases.

There is nothing that shows the efficiency of a factory any more quickly than the ratio of the selling value of the output to the total payroll. I have, therefore, taken this method of illustrating the profits in reorganization, which has been accomplished under the general direction of the author.

In March, 1908, the owner of the above factory, Sir Charles Ross, Bart., found that the annual returns from his factory (which had been in operation five or six years) were not satisfactory and called upon the author to report upon his plant. My mental picture was drawn somewhat as follows:

A factory temporarily located on a side street in the average loft building with a reasonable machinery equipment located at random, the tool equipment kept in cupboards in various parts of the shop and working under the usual unfavorable conditions that a factory generally operates in certain localities under adverse conditions and circumstances.

THE FACTORY BEFORE REORGANIZATION

Upon my arrival at Quebec, however, this picture was quickly obliterated. I found a group of neat, brick buildings pleasantly located on the Plains of Abraham overlooking the St. Lawrence river, with neatly finished offices; a well lighted and remarkably clean shop.

The machinery, tools and equipment were first class, and of such makes as Pratt & Whitney, Warner & Swasey, Bardons & Oliver, Brown & Sharpe; and the woodworking machinery for the manufacture of the rifle stocks from the best English factories.

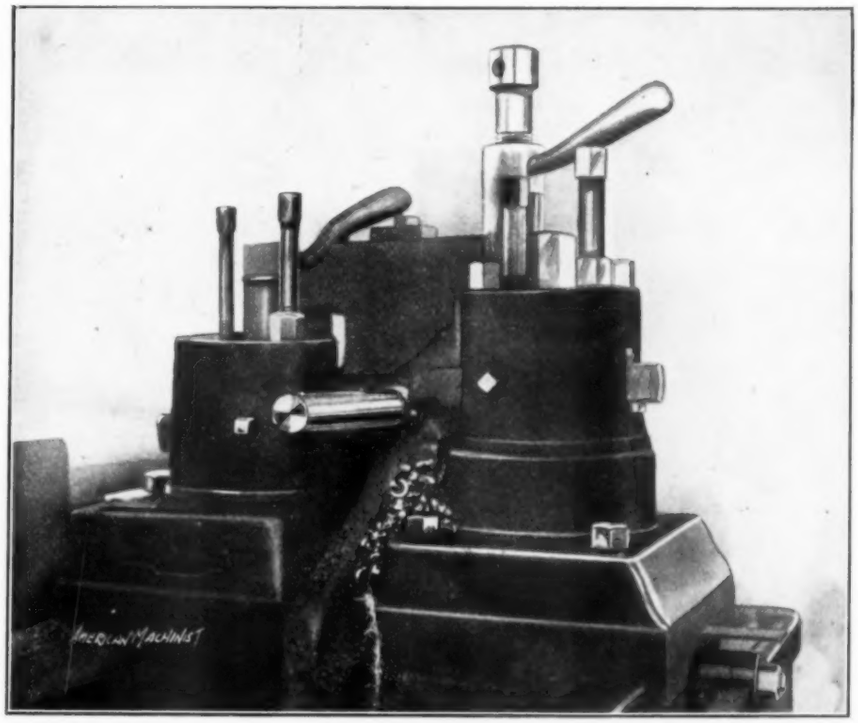
The drawing room was well arranged with complete drawings for all parts of the rifle, an arc-light blueprinting machine, proper indices and the record of all drawings, operation lists, tool lists and complete drawings of all tools, jigs and fixtures.

The cost department and order department for keeping track of the work were as good as in most American factories. The stock and store rooms were well lighted and arranged and equipped to handle the stock and supplies for the factory in much better shape than would be found in many shops in the United States.

The work of designing the rifle, tools, gages and fixtures, has been remarkably well done by some of the ablest engineers and mechanics, many of whom are still in the employ of the company.

With all the good points enumerated, however, the producing of the goods as a science had not received the attention that it should in order to produce commercial results.

The report of the author was practically embodied in the preceding para-



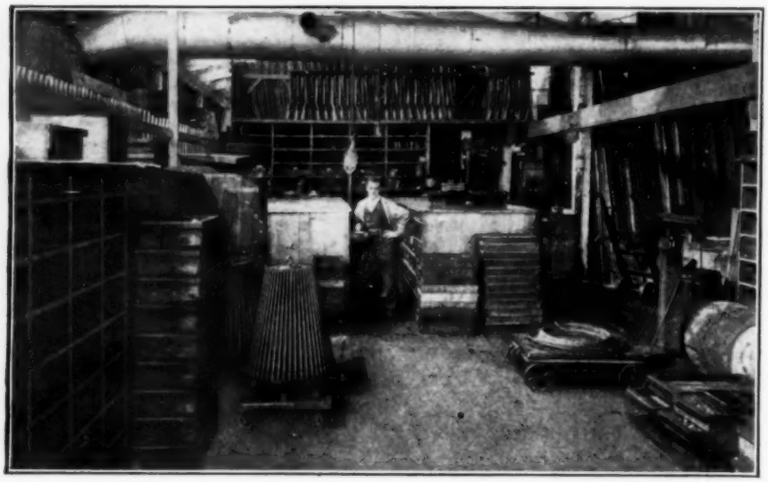
SPECIAL APPLICATION OF HIGH-SPEED STEEL

Roughing rifle barrels.
Removing 4 pounds of metal in 2.8 minutes, reducing from 1 1/8 diameter to 7/8-inch diameter,—cut 26 inches long, feed 1/8-inch per revolution. Note production: Old method, 3 lathes, 70 barrels per day. New method, 2 lathes, 125 barrels per day.

*Managing engineer, 37 Wall street, New York City.

CHIEF ENGINEER'S OFFICE

All product and tools are designed under the supervision of this office. Also processes and limits determined, operation sequence, speeds and feeds, time study, etc. The first operation list from this office is followed absolutely on first lots. Any changes in sequence are made on following lots if deemed advisable.



STORE ROOM FOR SUPPLIES AND FINISHED PARTS

Note method of handling work in trays or boxes that rest together and all can be slid into racks. Help required for operating store materially reduced and accurate information obtainable.

STOREKEEPER'S OFFICE

All orders for manufacturing are made out here. Cards on board show parts in process. Cards at left are records of stores and worked materials.

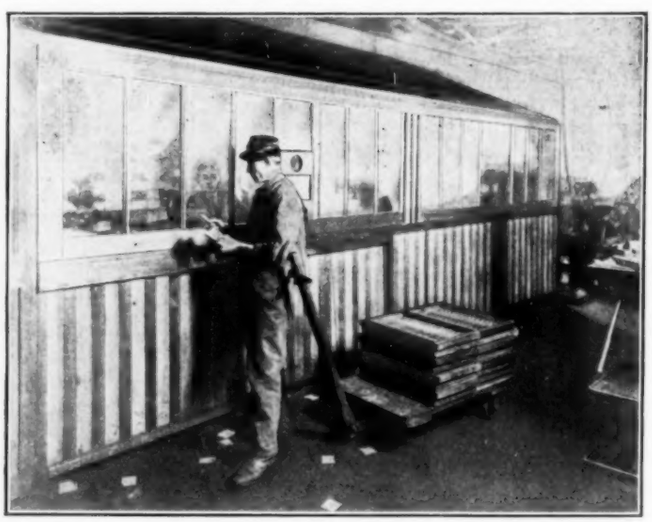
PRODUCTION CLERK

All time cards are received and given out here and stamped with clock, using the decimal system.

Requisition on stores for all materials used on productive work issued from this office.

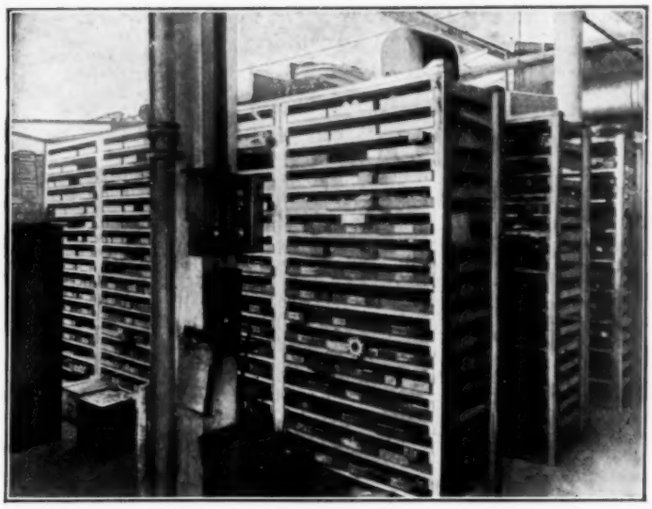
PAYROLL OFFICE

Payroll is made up here by assorting cards by men's numbers into tray on right and totaling same on adding machine and entering payroll under proper charge symbols. One man handles the analysis and making up of payroll of 400 men.



MOVE ORDERS

All work is transferred from department to department by "move orders." This shows truckman taking orders from order box, so as to get a return load after delivery of the pieces shown on truck. Work is thus gathered up "going" and "coming." Reduced cost of trucking, 60 per cent. Tickets are returned to other side of box after goods have been delivered and receipted for.



TOOL CAGE

This shows method of keeping tools in cage. Complete sets of tools in working condition are kept in trays for each operation. Steel racks are preferable but not economical in this case.

TIME-CARD RACK

Open before 7:00 a.m. and closed between 7:00 a.m. and 6:00 p.m. Tickets are kept by workmen during day or until job is finished in racks shown in Fig. 10.

graph. As a result he was retained by the company to reorganize the factory, which he has done, the results being shown by the diagram.

WHAT WAS DONE TO REORGANIZE

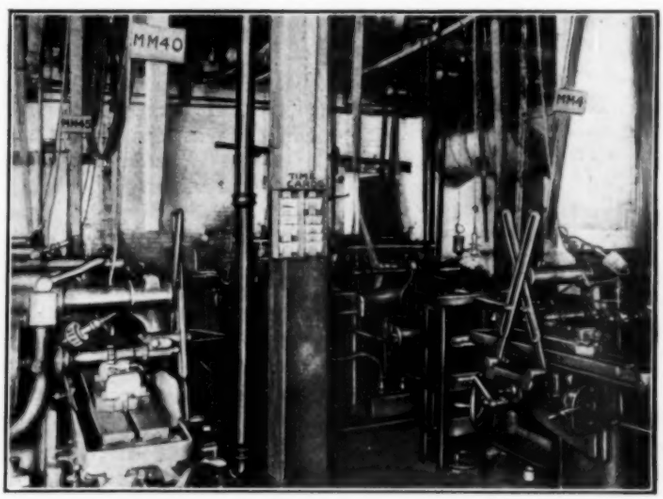
The general resumé of solving this problem was to carry out in approximate sequence the following:

1. Eliminate the cost department. Data were not reliable. Cost department showed a profit; the books of the company showed none.
2. Eliminate all non-producers possible.
3. Rearrange some of the machinery and departments.
4. Place work on piece rates by careful time study.
5. Study of speeds and feeds tending to the greatest economy.
6. Placing of the planning and routing of work in one place and under one man.
7. Placing a responsible chief at the head of the engineering, producing, inspecting and accounting divisions.
8. Reorganizing the methods of giving out and handling of tools for productive work.
9. A method of letters of instructions to division chiefs was introduced.
10. A system of authorizations to control expenditures.
11. A simple and accurate factory stores method.
12. Bonus system for division chiefs and foremen.
13. A true record of the monthly efficiency of the factory.
14. A simple method of charging accounts.
15. A time and payroll system in conjunction with the analysis of costs and expenditures.
16. A method of compiling accurate costs without excessive clerical help.
17. A tickler system for office and factory use.

The illustrations which accompany are typical and show the method of operating the different functions that are vital to the carrying out of this type of organization.

The work was not done by the use of forms but by the careful and judicious application of the methods which the forms symbolize, combined with the able assistance of the men at the factory.

You may turn a man loose in a drug store and he will be utterly at sea to know what medicine to take even should he be sick unto death. Give him a prescription, however, from his physician and the proper doses given at the proper



TIME-CARD RACK AND MACHINE NUMBERS

The time-card rack for use of men between 7:00 a.m. and 6:00 p.m. Machine numbers for convenience of truckmen and routing are shown on shipper rods.

COST DEPARTMENT

Costs are determined by either part number, operation number, or lot number, by assorting original time tickets and requisitions on stores into trays shown and totaled on adding machine. Costs, payroll and stores credits must check by this method.

time and he is soon restored to health.

There are more good factories killed by the overuse of forms than from lack of them and it should be borne in mind that it is not so much what you use as the way you use it.

Results on the Personnel

Some of the results in detail on the personnel of the factory are as follows:

a. No pencil work done by foremen or workmen.

b. A "fall-down" in production caught at once.

c. A constant pressure is exerted on all by locating responsibility.

d. Only the exceptions come to attention of the division chief.

e. The exact location of all work in process is determined without hunting the shop from end to end.

f. The correctness of all charges for all accounts.

g. Cost information obtained without additional expense and may be used or not as the case may require.

h. Complete control of the sequence of work.

i. Excuses are eliminated. The goods must be delivered.

j. Delays are readily located.

k. Minimum clerical help and number of forms.

The entire pay of the clerical force for this factory, including bookkeeper, paymaster, cost clerk, etc., is only 2 per cent. of the total weekly payroll, which includes salaries of division chiefs and foremen.

The average total number of employees during the period covered by this brief summary is 375.

The Angle and Lead of Herringbone Gears *By Chas. H. Logue*

To produce a herringbone gear to operate with a sample the calculations for which are unknown, is generally a matter of cutting and trying until a satisfactory gear is produced, as for herringbone or helical gears the angle and lead must be exceptionally accurate, the teeth having contact their entire length, and a slight error is noticeable. There is more or less leeway for spiral gears, but the method as described can be applied to them as well.

The Method

Cover the points of the teeth in sample with an application of lampblack, or anything that will make a clear impression on a piece of clean white paper. Roll the gear thus treated on the surface of the paper, being careful not to allow it

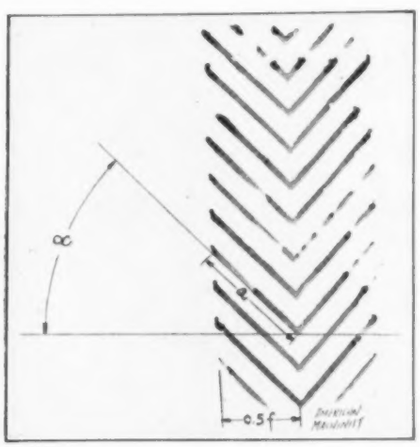


Fig. 1. Impression made by Rolling Sample Herringbone Gear

to slip, until a clear impression of the points of the teeth is made, as illustrated by Fig. 1. This will represent a development of the teeth at the outside circumference.

The angle of the teeth at the outside circumference may then be measured with a protractor by extending the lines of the tooth as developed on the paper, and a line drawn at right angle to the gear face, which represents the axis, or, this angle may be calculated as by formula 1.

f = Face of herringbone gear.
a = Length of the tooth from center of face.
α_1 = Angle of spiral at outside diameter.
α = Angle of spiral at pitch diameter.
L = Lead of spiral.
C_1 = Outside circumference.
C = Pitch circumference.

$$cos.\ \alpha_1 = \frac{0.5\,f}{a}. \qquad (1)$$

For helical gears this formula would be:

$$cos.\ \alpha_1 = \frac{f}{a}. \qquad (2)$$

The next step is to find the lead:

$$L = C_1\ cot.\ \alpha_1. \qquad (3)$$

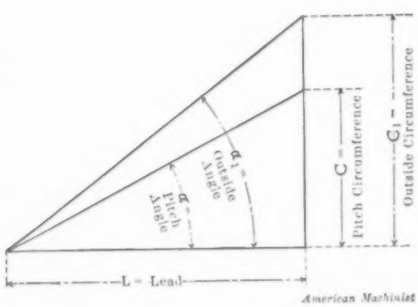


Fig. 2. Diagram of Angles of Herringbone Gear

As the lead is necessarily the same at the outside diameter as it is at the pitch diameter of a helical or spiral gear when cut with a rotary cutter, the angle of spiral at the pitch line may be found by formula 4.

$$Tan.\ \alpha = \frac{C}{L}. \qquad (4)$$

The fact that the lead is the same at all points when cutting a spiral, helical or herringbone gear on a universal milling machine or spiral gear cutter using a single rotary cutter, makes the solution of this problem a simple matter. Fig. 2 will be self explanatory.

This being the case, it is apparent that such a cutter cannot reproduce its own shape in the gear blank, as to do this the angle and lead must be proportional at all parts of the tooth. When the teeth are generated this condition is fulfilled and the angle at the pitch line will be proportional to the pitch and outside circumferences, or:

$$\alpha = \frac{\alpha_1 C}{C_1}. \qquad (5)$$

The pitch diameter may be readily determined by a measurement of the tooth parts of the sample.

Pitch diameter = outside diameter — 2 × addendum.

Removing Grease with Soda

A bath of potash or soda lye has been commonly used for the purpose of removing grease, oil and similar substances from metallic objects. Usually the objects are dipped into the bath of potash or soda lye and kept immersed until all traces of the substance desired to be removed have been absolved from the metallic parts. This process is somewhat slow, however, it taking from ten to fifteen minutes immersion usually before the oil or grease is thoroughly removed from pieces of sheet iron, for instance. A much quicker method is now reported as having been introduced in Germany, which simply consists of an electrolytic removal of the oil or grease. It is accomplished by making the metal parts act as a cathode in a solution of carbonate of potash heated to a temperature of about 100 degrees Centigrade. The current is turned on and all traces of the oil or grease are removed from the parts in a very few minutes, the rapidity of which is explained by the German investigator introducing the method as due to the mechanical action caused by the bubbles of hydrogen generated at the cathode.

The Various Effects of Phosphorus on Steel

By E. F. Lake

Phosphorus always occurs in nature in the combined condition, and unites with metals to form phosphides. It forms two oxides, which are P_2O_3 and P_2O_5, and also forms compounds of the same character and similar composition to arsenic, antimony and bismuth, and is consequently placed in the same chemical group as these.

It is always encountered in reducing iron ores and is a very difficult element to entirely remove from the finished iron and steel product. In these materials it must be reduced to as low a percentage as possible, as phosphorus is without doubt the most injurious element that is found in steel, notwithstanding the fact that in the past many experiments have been carried on that apparently proved that phosphorus up to about 0.12 per cent. strengthened steel. When these same steels were put into actual use, however, failures occurred, and the cause was nearly always traceable to the phosphorus.

In the rolling mills phosphorus does not show any bad effect, as the heat under which the steel is worked seems to overcome this, but when the metal has become cooled and is subjected to sudden shock or to vibrational stresses, it breaks very easily. The lower the temperature and the higher the phosphorus, the easier will the breaks occur. This has led to the term "cold shortness" as applied to the effect of phosphorus on steel.

Phosphorus diminishes the ductility of steel under gradually applied load as shown by the reduction of area, elongation and elastic ratio when specimens are pulled apart in the ordinary static strength testing machines. But when the steel is tested in the rotary or alternating vibrational testing machines, as well as with a pendulum impact machine, the decrease in ductility and toughness is shown to a greater degree. Phosphorus also reduces deflection, and the rigidity thus imparted might be considered an advantage for structural purposes, although even this is doubtful, owing to the metal's weakness at low temperatures, and when subjected to shocks.

Phosphorus steels are so capricious that they may show a reasonably high static ductility and still show very brittle when shock tests are applied. Therefore the safest rule to apply is to have the phosphorus in all steel products as low as possible. It is a very poor steel that contains 0.10 per cent. of phosphorus. The ordinary grades contain as much as 0.08 per cent., and the high-grade steels should have less than 0.04 per cent., while in the very best steels it should be even lower than this. In fact, this has been reduced to below 0.01 per cent. in some of the electric-furnace steels, and occasionally a mere trace is all that is left in the finished product.

Phosphorus gets into the metal by entering the blast furnace with the ores in the form of metallic phosphates—the form in which it is usually found in nature—and mainly as phosphate of lime, which is a natural mineral named apatite. Many metallic oxides unite with it to form salts, especially iron and magnesium oxides and lime, but in the presence of silica, which is a stronger acid, it is driven away from the slags and returned to the iron until the silica has been satisfied.

In steel phosphorus has a tendency to cause coarse crystals to form, and this tendency is increased with each percentage of carbon. It also forms the phosphide Fe_3P, and this forms a series of alloys with iron. The eutectic of this series contains 64 per cent. of this phosphide, which equals 10.24 per cent. of phosphorus. A certain percentage of phosphorus will dissolve in pure iron and no eutectic will form to produce brittleness, but when carbon is added, each increase in percentage exerts an influence on the phosphorus that causes it to precipitate from the solid ferrite solution and take the eutectic form. Therefore the more pure the iron and the less cementite that is in the steel, the greater will be the decrease in brittleness that is caused by phosphorus, while each increase in the percentage of carbon increases the tendency of the eutectic to form and the steel to assume a coarser crystallization, and this makes it both weaker and more brittle.

Phosphorus is removed from steel to a different degree by the different processes of manufacturers. Thus bessemer steel contains the highest percentage of phosphorus, while the other steels contain gradually decreasing percentages in the order in which they are named. Acid open hearth. Basic open hearth. Crucible. Electric. The acid open-hearth furnace requires ores low in phosphorus, while in the basic it is removed by adding a sufficient amount of lime to the slag, and in the crucible and electric furnaces it is removed by using the proper flux.

One of the latest methods consists of using an oxidizing slag in such a way that it will combine with the phosphorus and form a phosphate, and then adding a reducing material to the slag that will convert this phosphate into a phosphide. The reducing material is usually ground coke that floats on top of the slag and reduces the phosphate without interfering with the molten metal below. Owing to the strong combination of the phosphide, the phosphorus cannot be separated out by the iron, without first being changed back to phosphate, and this is impossible in a reducing atmosphere.

One charge that was dephosphorized in the Heroult electric furnace was taken from a bessemer converter and analyzed: phosphorus 0.10 per cent., sulphur 0.16 per cent., manganese 0.10 per cent., carbon 0.07 per cent., and silicon, traces. When a 15-ton charge of this was put in the furnace a black slag composed of 400 pounds each of mill scale and lime was added. This made an oxidizing slag that became fluid when the molten metal below was thoroughly oxidized and all the phosphorus had passed into the slag as phosphate of lime (CaO). Ground coke was then added to the top of the slag and this reduced the phosphate therein to calcium phosphide (P_2Ca_3). Without removing the slag the required amount of carbon, silicon, manganese, etc., were added. That there was no return of phosphorus to the steel is shown by the analysis of the final product, which was, phosphorus 0.005 per cent., sulphur 0.005 per cent., with the carbon ranging from 0.05 to 1.50 per cent., and the manganese and silicon as desired.

A high-phosphorus steel is sometimes used for the third rail in an electric railway, as phosphorus will increase hardness without decreasing electric conductivity as other ingredients would, and it also decreases the purity of the iron less than any other material. This gives the rails the necessary hardness and purity to withstand the abrasive wear caused by the contact shoes, as well as giving them the necessary conductivity.

Phosphorus reduces the melting point, makes the metal more fluid and prolongs the period of solidification of all of the iron products. This is made useful in such work as art castings, where a detail of figure is of more importance than strength, as the metal fills every minute crevice in the molds. By keeping the metal in a pasty state for a long time or retarding solidification, the phosphorus allows the graphite to be expelled from the solid solution and occupy spaces between the particles of iron. This action causes the metal to expand and press into every tiny cavity in the mold, and the higher the percentage of phosphorus the longer will the solidification be delayed. Certain chemical conditions caused by too much phosphorus, too little silicon, etc., might overcome this by exerting a tendency to keep the carbon in the combined form. A decreased shrinkage because of this expansion may also be caused when the phosphorus separates from its solution in the ferrite and forms a eutectic. Phosphorus and also sulphur increase the tendency toward segregation.

Mean Effective Pressure on Air Compression* *By H. L. Seward*

Each of the accompanying diagrams consists of three straight-line scales so placed that if a straight-edge be laid across them, the readings of the scales where the straight-edge crosses them, will satisfy the formula

$$M.E.P. = 3.46\,P_1\,(R^{0.29} - 1).$$

When any two of the three variables (M.E.P.), P_1 or R are given, the third may be immediately determined by laying a straight-edge over (or drawing a straight line through) the two given quantities and noting the reading under the straight-edge on the third scale. For example, if P_1 is given as 32 pounds per square inch absolute, and R as 5, then in Fig. 1, a straight line from 32 on scale P_1 through 5 on scale R shows that the M.E.P. must be 65.8. Or if P_1 is 20 and R is 7, Fig. 2, shows that the M.E.P. must be 52.5.

For the benefit of those who might wish to construct these diagrams on a little larger scale, the following method of construction is given:

Method 1. (Fig. 1).

At point A, draw a vertical line $A\,D$, 5 inches long and draw $A\,B$ so that the angle $D\,A\,B = 120$ degrees. Make $A\,B$ ten inches long. At D and B draw horizontal lines $D\,E$ and $B\,C$, respectively. Upon $B\,C$ lay off a scale of 20 to the inch for the scale of M.E.P. From D measure $D\,F = 1.72$ inches as shown, thus locating the point 15 on the scale for P_1. From F continue the scale P_1 as far as desired, making the distance from one graduation to the next equal to 0.692 inch. If desired each space may be subdivided into 10 equal parts so that the scale reads to hundredths.

The points on the scale for R are located by computing the distance in inches of each point from A by means of the formula

$$x = \frac{0.5\,(R^{0.29} - 1) - 2}{0.5\,(R^{0.29} - 1) + 2} \times 10$$

where x is the distance of any point R from A. For example, to locate the point 8 on scale R we have

$$x_8 = \frac{0.5\,(8^{0.29} - 1) - 2}{0.5\,(8^{0.29} - 1) + 2} \times 10 = 6.57\ inches.$$

The computation from this formula is not as difficult as it might seem at first sight, if carried on systematically. In the following table the values of R in the first column were written down one under another. Each one was raised to the 0.29th power by logarithms and results written in the second column. Then 1 was subtracted from each number in the second column to obtain the values in the third column. Values in the third column divided by 2 gave the fourth column of figures. Then each of the numbers in the fourth column was subtracted from 2 which gave the values in the fifth column. Values in the fourth column added to 2 gave the numbers in the sixth column.

R	$R^{0.29}$	$R^{0.29} - 1$	$0.5\,(R^{0.29} - 1)$	A $0.5\,(R^{0.29} - 1) - 2$	B $0.5\,(R^{0.29} - 1) + 2$	$\frac{A}{B}$ $\frac{x}{10}$
1	1.000	0.000	0.000	—2.000	2.000	1.000
2	1.223	0.223	0.112	—1.888	2.112	0.889
3	1.375	0.375	0.188	—1.812	2.188	0.829
4	1.495	0.495	0.248	—1.752	2.248	0.780
5	1.595	0.595	0.298	—1.502	2.298	0.742
6	1.682	0.682	0.341	—1.659	2.341	0.708
7	1.758	0.758	0.379	—1.621	2.379	0.682
8	1.828	0.828	0.414	—1.586	2.414	0.757
9	1.891	0.891	0.446	—1.554	2.446	0.636
10	1.950	0.950	0.475	—1.525	2.475	0.617
11	2.004	1.004	0.502	—1.498	2.502	0.598
12	2.058	1.058	0.529	—1.471	2.529	0.583
13	2.104	1.104	0.552	—1.448	2.552	0.568
14	2.150	1.150	0.575	—1.425	2.575	0.553
15	2.193	1.193	0.597	—1.403	2.597	0.539

The quotient of numbers in the fifth column divided by numbers in the sixth, gave the last column. This last column, multiplied by 10 gives the desired values of x.

All three scales may be continued in length up to any desired limit.

Method 2. (Fig. 2.)

Draw $B\,A$ and $A\,q$ at right angles. On

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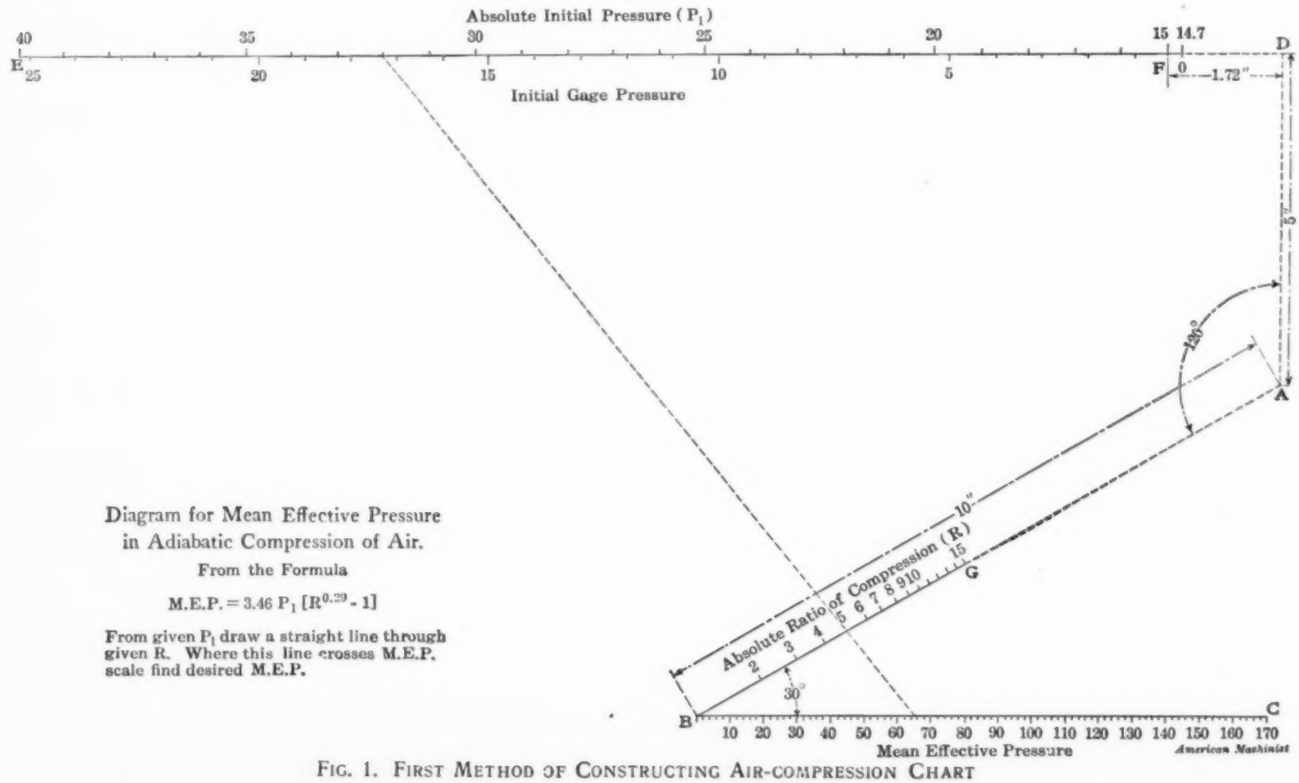


Diagram for Mean Effective Pressure in Adiabatic Compression of Air.

From the Formula

$$M.E.P. = 3.46\ P_1\ [R^{0.29} - 1]$$

From given P_1 draw a straight line through given R. Where this line crosses M.E.P. scale find desired M.E.P.

FIG. 1. FIRST METHOD OF CONSTRUCTING AIR-COMPRESSION CHART

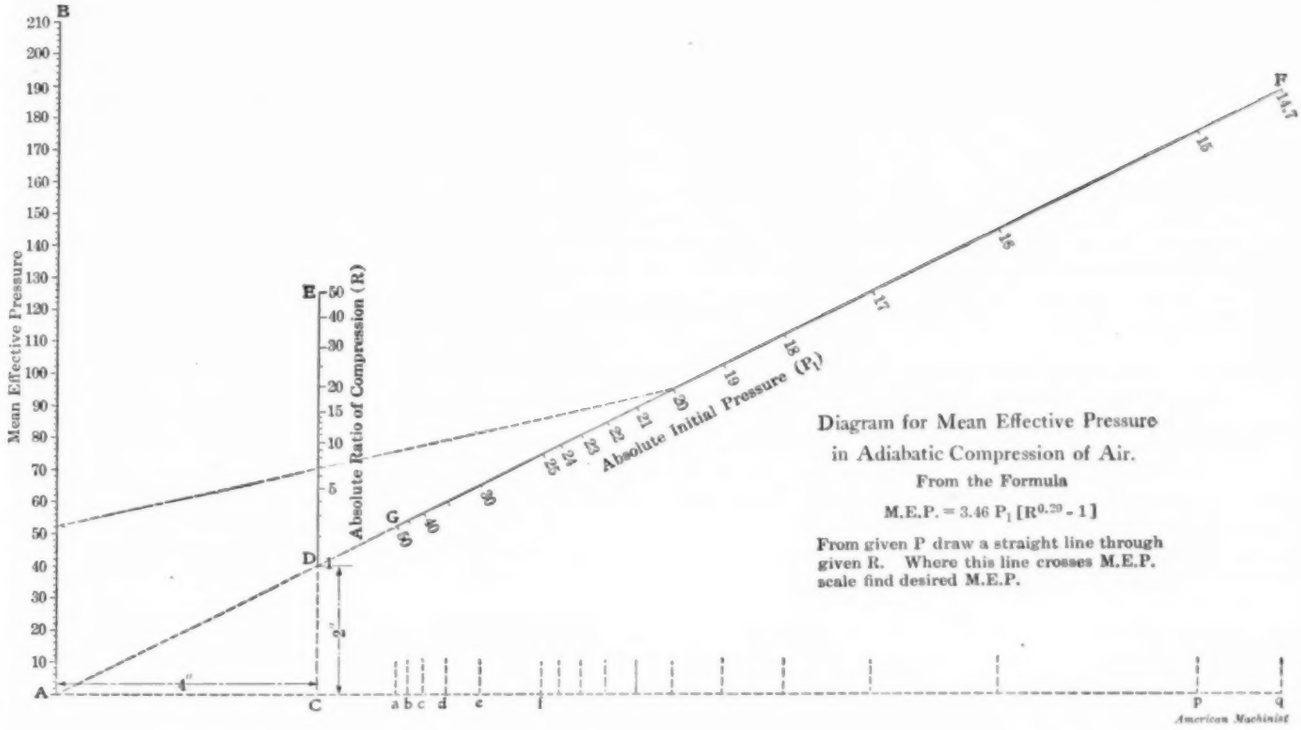


FIG. 2. SECOND METHOD OF CONSTRUCTING AIR-COMPRESSION CHART

$A\,B$ lay out a scale for M.E.P., 20 to the inch. Draw $C\,E$ parallel to $A\,B$ and 4 inches away from it. Through A draw $A\,F$ with a slope of 1:2 that is, $A\,C$ will be 4 inches and $C\,D$, 2 inches. The scale for R on $C\,E$ is laid out with values of $R^{0.29}$ multiplied by two inches. These values may be taken from column 2 in table above. For example, the distance from C to point 9 on scale R is $2 \times R^{0.29} = 2 \times 1.891 = 3.782$ inches.

To plot the points comprising the scale for P_1 it is easier to locate the points $a, b, c, d \ldots\ldots q$ on $C\,q$ directly underneath. These are located from the formula

$$x = \frac{-8}{-0.173\,P_1 + 2}$$

For example, to obtain the point 30, we have

$$C\,e = \frac{-8}{-0.173 \times 30 + 2} = 2.51 \text{ inches.}$$

Locate point e 2.51 inches from C and erect a perpendicular to $C\,q$ at e. Where this perpendicular crosses $A\,F$ gives point 30 on scale P_1.

The two diagrams are two different arrangements of points for accomplishing the same end. Fig. 1 is probably the more accurate of the two, due to the sharper intersections, but Fig. 2 would be more convenient in cases where higher values of P_1 are to be used.

The Desirability for Model Machines

By J. M. Williams

In many of the papers, any person who is interested in machinery of any kind, will have noticed many of the following advertisements: "Patent Your Ideas," "Send for Our Free Book," etc., etc.; or "Models of Any Kind Made to Order from Your Own Drawings."

I will grant that the above are all very well, but what about the first expense for a working man with a family, even if he has an idea that is worth patenting?

There are many persons who have ideas that could be added to machines of different kinds, if it were possible to purchase a model at a moderate cost. I will take, for instance, a loom fixer who has an idea worked out (in theory only) of how to add an improvement to a loom that will instantly indicate where an end is broken, without closely looking across the loom to see that all is in order; or take a spinning section hand who has an idea to do away with the cylinder and bands of a spinning frame.

If in either of the two cases mentioned (and there are a great many more) a person wishes to try an experiment, the result is he must pay for a special model before he can commence operations. In fact, scores and scores of working men would go in for a small model of the machine they are specially interested in, if they only knew where to buy one at a moderate cost.

I myself know of a machine outside the two I have mentioned, that I could greatly improve, but am held back for want of capital. I had plans of the machine drawn by an experienced draftsman, then found a model maker, who would make a model from the drawings for me for a certain sum that at present is out of the question, especially when I should have to provide funds to patent the idea also.

I would like to impress upon some firm of model makers that if they will take up the idea, putting upon the market models of machines that are largely used, I have no hesitation in saying it will well repay them for their experiment, because there are many workmen who would receive with open arms the opportunity of procuring a model of the machine they are specially interested in, for the simple reason they could then try their experiment at very little extra cost, without having to let their foreman know all about their ideas. As the AMERICAN MACHINIST has many readers who are workmen in a similar position to myself, I would suggest that you invite correspondence from them upon the above subject.

Trend of Steel Specifications to Meet Present Requirements

A Review of the Various Steel Alloys and Their Capacities

By C. A. Tupper

When it is remembered that only within the past twelve to fifteen years have there been any general specifications required in the purchase of steel, except as to the carbon content, the progress now being made is hardly short of phenomenal.

Although, for example, the convention of the American Society for Testing Materials was held only a few months ago and the reports made by the special committees have not yet received the attention due them, there is already manifest a disposition among users of steel, including the leading builders of high-speed machinery, to draw specifications for rolled, forged and cast stock considerably in advance, i.e., more rigid than those which were suggested on that occasion as desirable standards.

This is perhaps due to the condition that the recommendations made to the society, like all conclusions of committees, have in them elements of compromise; but it must also be ascribed to the fact that, during the long period of business depression, many shop superintendents, engineers and structural steel men found opportunity of conducting more than ordinarily careful tests and have reached independent conclusions by which they will be governed in their own methods of manufacture or erection. A large increase in the tensile strength and elastic limit is generally demanded by steel users; and, while the elastic limit of most steels has heretofore stood at about one-half ultimate strength, the percentages now required range materially higher, according to the character of the service. In this connection, also, it should be borne in mind that the true elastic limit of any steel is about 10 per cent. less than the showing made in tests, because of the fact that the latter corresponds to the actual yield point found on the testing machine.

In the following it is the intention of the writer to give a review of some recent tendencies, without going too much into details specifically covered by other articles appearing in the past in the AMERICAN MACHINIST, the majority of which, so far as his observation goes, agree very closely with current practice among the more advanced users of steel.

High Speed Rotating Parts

For carbon-steel masses of considerable weight rotating at great speed, such as the body of the spindle of a horizontal steam turbine running up to, say, 3600 revolutions per minute, metal of high endurance, having a tensile strength of 85,000 to 100,000 pounds and an elastic limit of 55,000 to 70,000 pounds is now required, with elongation in 2 inches of 25 to 30 per cent., contraction 40 to 48 per cent. The same is also true of other rotating elements turning at much slower speed but subjected, at the same time, to heavy pressure or resistance, such as the runner of a hydraulic turbine or the impeller of a centrifugal pump.

From the standpoint of safety this requirement is, of course, far more important for the first named, where the rotor has a tendency to burst from centrifugal force (nickel, chrome, vanadium and other special steels for rotors will be separately considered further on); but, as an operating factor, it is no less necessary in the production of machinery utilizing or handling large quantities of water.

For pumping engines, however, the conclusions of manufacturers and engineers vary, some being of the judgment that an ultimate tensile strength of 55,000 to 60,000 pounds is ample, though an elastic limit of at least 30,000 to 40,000 pounds is required. Elongation in 2 inches (the present tendency apparently being to adhere to that standard) of 20 to 28 per cent. and contraction of 35 to 45 per cent. with between 25 and 35 per cent. satisfactory, are allowed for under these conditions. Sulphur and phosphorus should not exceed 0.05 per cent. each, and some users place 0.02 to 0.03 per cent. as the limit.

Steel Billets

In the purchase of steel billets, manufacturers find, as a matter of shop economy, that it is advisable to carry, as far as possible, stocks of generally suitable characteristics, rather than divide specifications. In this respect present practice shows considerable reaction from the tendency of a year or two ago to carry the division to extremes. The object now sought is to secure steel having characteristics not only suitable originally to the purpose required, but also capable of maintaining or improving upon those under proper treatment, and commercially usable.

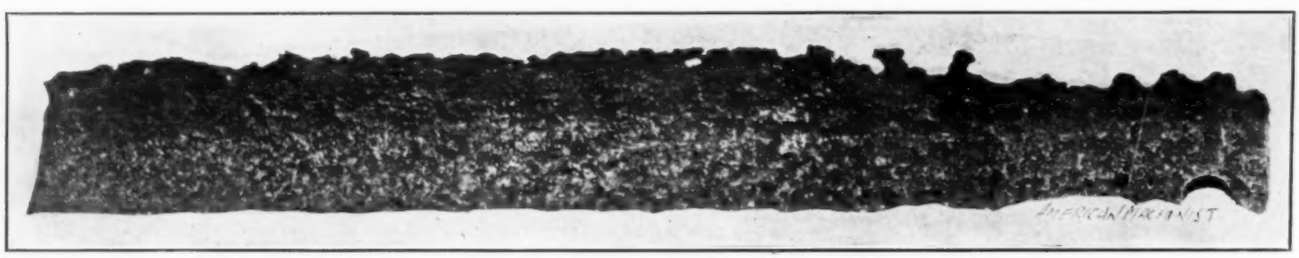


Fig. 1. Effect of Corrosion on High-Carbon Steel Turbine Blade

The last named is a point too often ignored by theorists in a discussion of this kind, even though the most advanced thought of today may be the commonplace of tomorrow; for, no matter how desirous a manufacturer may be of improving the quality of his product, he is restricted by market conditions affecting its sale, and there are certain limits beyond which he may not go.

The machinable qualities of special steels, and the extent of the heat treatment to which they need to be subjected after each operation, or series of operations, are also factors that have to be weighed carefully in the commercial balance. Sometimes a relatively small difference in shop costs may be sufficient to tip the scale one way or another.

Carbon Contents and Overheating

As to the carbon content, the grade of billet best adapted to engines or other machinery having a reciprocating motion, where no excessive strains or stresses are likely to be set up, should run from

25 to 33 points. These can be machined to better advantage than the 50-point carbon steel often recommended. In annealing, such steel is customarily heated to from 1650 to 1800 degrees Fahrenheit for 10 to 12 hours, and allowed to cool very slowly. A higher temperature of heating is permissible, but not above the extreme limit reached in forging and most manufacturers fear to go above 1850 degrees Fahrenheit. For the greater tensile strengths required in the operation of such machinery, up to, say, 70,000 pounds, use of 33- to 35-point carbon steel is to be recommended.

It should be recognized that overheating is more injurious to high-carbon steel than too low; also, that if the reduction in hammering or pressing has been great enough so that the coarsening of the grain at the high temperature to which the steel has been heated prior to such hammering or pressing has been well effaced, the harm of overheating increases not only with the distance above the final point of recalescence to which the temperature is raised, but also in direct ratio to the percentage of carbon. Steel that has become dangerously crystalline may —in many cases, at least—be restored to specification conditions, or better, by reheating and manipulation; but the necessity for this ought to be avoided just as far as possible.

Carbon Content for Different Parts

For less particular service, such as ordinary shop machinery, the usual stock billets of 15- to 25-point carbon, having a tensile strength of about 55,000 pounds, elastic limit practically negligible, and purchased with no more than ordinary physical or chemical requirements, are regarded as sufficient for all purposes.

For special machinery parts subject to excessive wear, such as crank pins, valves, compression rods, table clutches, return cranks, etc., a carbon content of at least 50 to 55 points is needed. Such forgings, or even castings, should also show an ultimate tensile strength of at least 75,000 pounds, if not annealed, and a minimum of 65,000 to 75,000 pounds if thoroughly annealed, with elastic limit, elongation and concentration correspondingly high.

For carbon-steel shafts and axles subjected to heavy strains (the tendency now being, however, to use some special alloy such as vanadium) the requirements of machinery and truck builders vary considerably, but a content of 0.35 to 0.45 per cent. carbon, manganese not above 0.45 to 0.50 per cent., silicon 0.05 per cent., sulphur not to exceed 0.03 per cent and phosphorus within 0.04 per cent are considered safe. In actual manufacturing, where such steel is used, these standards have not heretofore been very generally realized, but the increasing frequency of accidents and breakdowns, under the severe requirements of modern power, mill and traction service, is compelling builders to draw the lines tighter and tighter.

It should be remembered, however, that the greater the percentage of carbon in billets, the higher is the temperature required in forging—not less than 1650 degrees Fahrenheit for high-carbon steel; hence costs may be kept down by using billets as low in carbon as the requirements of the finished product will permit.

Strengths for Different Parts

The selection of the proper steel for crank pins has always been a vexed question, particularly where such parts are subjected to heavy stresses and the force of sudden shocks—as in the case of a reversing engine for rolling-mill service, when the rolls bite the ingot. 45- to 55-point carbon steel, with tensile strength of 75,000 pounds will meet ordinary requirements of "heavy duty," but for continuously severe operating conditions, as in the instance above cited, a special alloy steel such as chrome vanadium of high tensile strength and great toughness is desirable. An example of this will be found in the accompanying table.

For large traveling cranes a leading builder states that the grade of castings best suited to his requirements is of open-hearth steel, having an ultimate tensile strength between 66,000 and 68,000 pounds, elastic limit of 33,000 to 35,000 pounds, and chemical content of 0.24 per cent. carbon, 0.48 per cent. manganese, 0.20 per cent. silicon, 0.06 per cent. phosphorus, and 0.04 per cent. sulphur. Steel for truck wheels carries 0.03 per cent. carbon, 0.59 per cent manganese, 0.63 per cent. silicon, 0.454 per cent. phosphorus and 0.152 per cent. sulphur; truck-wheel tires 0.44 per cent. carbon, 0.78 per cent. manganese, 0.28 per cent. silicon, 0.38 per cent. phosphorus and 0.048 per cent. sulphur. The figures given are taken from actual tests of steel that, all things considered, has proved most satisfactory. For pinions, armature shafts, truck axles, etc, a rolled open hearth steel, 30 to 35 points carbon is used, and, for the cross shafts on the crane bridges, turned and ground shafting that runs high in carbon. The steel and other metal used in the construction of the crane-motors is such as electrical manufacturers employ in building high-grade motors for heavy duty.

Steel Used in Boilers

For boiler-tank steel there has been little, if any, change in the best practice of the past few years, as steam pressures have remained practically constant, and fluids do not, of course, change their characteristics; but some authorities are now placing a limit of 0.04 per cent. on phosphorus and 0.03 per cent. on sulphur, with allowance of 0.06 per cent. and 0.04 per cent., respectively, in flange steel. The ultimate tensile strength required ranges from 55,000 to 70,000 pounds; elastic limit not less than half. A new element entering this field is the increasing practice of using boiler plate in connection with casings, feedpipes, etc., for huge hydraulic power developments, and what the effect of that will be it is too early as yet to say.

Specifications for fire-box steel are, in general, very close to those standardized in flange and boiler plates, a slightly lower tensile strength and elastic limit being accepted, with increased ductility.

Rivets for all three classes are usually of so-called "extra soft," steel, having tensile strength of 45,000 to 55,000 pounds and elongation of test bars (8 inches) of at least 28 per cent. A prominent manufacturer advertises an elongation of from 30 to 34 per cent.

For steel cars, plates low in carbon, say 0.15 per cent. and manganese about 0.35 to 0.40 per cent. have been used, but the tendency at present is toward an alloy steel having great toughness and resistance to vibration and fatigue as well as the usual elements of strength, and which, at the same time, is not too expensive.

Nickel Steel

Some years ago attention was directed, by tests of the new armor plate made for naval vessels, to the great tensile strength, toughness and ductility of the then little-known nickel steel. Experiments with shafts, axles, spindles and other parts of vehicles or machinery rotating at considerable speeds also showed that it possessed the extremely valuable quality of resistance to "fatigue," that it readily withstood shocks of all kinds as well as those of shell impact and that steel high in nickel was practically non-fissible, i.e., not subject to cracking or similar rupture.

Furthermore, steel having the proper combination of nickel and elements commonly used, including in some cases small proportions of other alloys, was discovered to possess a degree of resistance to both erosion and corrosion which enabled it to play an important role in the development of machinery in which vapors or acidulated gases press with considerable force against moving parts. For service of this character, however, other metal alloys, the composition of which is rigidly kept secret, are quite generally displacing steel. A typical example of this erosion and corrosion is shown in Fig. 1. This is from a photograph of a high-carbon steel turbine blade that was taken after it had been in service two years. A special alloy steel is now used which entirely eliminates such effects.

Forgings made from nickel steel have, in general, the same requirements as those of ordinary carbon steel of the same class, with the addition of 2.5 to 3.5

per cent. nickel. This raises the ultimate strength anywhere from 10,000 to 80,000 pounds per square inch (depending upon the other characteristics of the metal), and the elastic limit in proportion, without sacrificing the ductility. In fact, the last-named is usually increased.

The proportions of nickel commercially usable in large forgings intended for machinery parts are limited by a curious property of the metal, viz., that its mixture in high-carbon steel up to a certain percentage and beyond a certain percentage increases the hardness of the steel. Between these two points there is a small range, the working limits of which are about as stated above, in which nickel steel can be machined to the best advantage. For low-carbon nickel steel the range is somewhat greater, and it can be easily worked cold with nickel under 3 to 5.5 per cent.

Specifications for small forgings, which are subsequently to be reduced by grinding, may call for as much nickel as is desirable. Steel can be forged readily, without regard to its nickel content.

Nickel-steel forgings, also, do not ordinarily need annealing, except where the latter is intended to be carried to the tempering stage, as there is already sufficient homogeneity in the structure.

Vanadium Steel

Allowing, however, for the truth of all that has been said above, it is a fact indicative of the rate of modern progress that for many purposes nickel steel has already had its day, and the addition or substitution of other alloys, to form such combinations as chrome nickel, nickel vanadium and chrome vanadium steels, has become general. Vanadium has an even more favorable effect than nickel alone and increases the ductility and toughness of the steel containing it. This is now used for engine, locomotive and automobile parts, as well as in bridges, viaducts or other structures where there is much vibration. Chrome-nickel enters similarly into the composition of machinery steel. Titanium appears to give results even better than those mentioned (although this is not generally conceded) and at the same time does not appear in the finished product. It apparently acts as a scavenger to remove impurities.

Advocacy of vanadium steel is particularly strong at present among the expert metallurgists employed by machinery builders, and the claims presented in its behalf are very clearly—although somewhat diffusely—set forth in a treatise by J. Kent Smith, which the reader will find summarized in the October, 1909, issue of "The Chemical Engineer." Careful consideration of the points made will well repay anyone having a practical interest in the subject of this article.

The growing popularity of vanadium and other steels is certain to result before long in a general recasting of specifications along many lines, but space will not be taken here for any extended discussion of that phase of the subject. More, too, can be said with confidence a little later on. The element of cost as compared with carbon steel is an important consideration in the design of machinery sold on a competitive basis.

Quarternary Alloys

A chrome-nickel, chrome-vanadium, chrome-nickel-vanadium or other special alloy steel used for the rotating parts of extremely compact, high-speed machinery is ordinarily required to have an ultimate tensile strength of about 120,000 pounds, with elongation of 16 to 30 per cent. in 2 inches and the extremely high elastic limit of 100,000 pounds. Where such machinery is subjected to extraordinary stresses, however, the tensile strength may run as high on test as 165,000 to 175,000 pounds, with elastic limit very little under these figures and elongation up to 32 per cent. or beyond. Contraction varies so largely that any general figures are very misleading and each test result should be taken by itself. The extreme limit seems to be 65 to 70 per cent. in 2 inches.

In the forging of these alloyed steels, much more than in their machining, special skill is usually required, particularly when they are high in silicon; and the temperature must be maintained at above 200 to 250 degrees Fahrenheit under the melting point, thus necessitating, with a large piece, several reheatings, it being a well recognized fact that forgings made at a temperature just above the final recalescence point are always strongest. A small variation in the proportioning of the alloys makes considerable difference in forging conditions; hence machinery builders find it necessary to check their specifications very closely with the results of actual tests in the shop, before arbitrarily demanding this or that from the steel manufacturers. Failure to proceed very cautiously on that basis has, not infrequently, led to heavy losses.

Demands on Steel Mills

Right here it may be observed that there is far too great a tendency on the part of machinery builders to criticize manufacturers of steel for failure to respond with alacrity to some of the demands made upon them in the way of specifications. Hardly a mill operator in the country is not willing to make any special heats required, if he can do so in sufficient quantities to justify such a course, as more profit is usually obtainable on special stock; but how can he be expected to do this on small orders from individual shops, unless the use of a particular grade of steel has become sufficiently general to enable a profitable aggregate of such orders to be obtained? Moreover, the leading steel manufacturers are in a position to offer their customers disinterested advice of a thoroughly practical nature; it is not for nothing that they maintain expensive testing laboratories and keep a close watch on tests made by others, the world over.

Steel for Springs

For springs used in connection with machinery, the ordinary carbon steel specified has a chemical composition about as follows: carbon 0.95 to 1.05 per cent.; manganese 0.025 to 0.040 per cent.; silicon 0.12 to 0.15 per cent.; phosphorus and sulphur not over 0.03 per cent. each. The elastic limit to be expected from such steel varies so much with the heat treatment and the methods of tempering used that any general statements are without value. The highest figures I have observed were given in a paper read before the International Society for Testing Materials, September 9, 1909, for steel of approximately the above characteristics hardened in water at 1425 degrees Fahrenheit and drawn to 750 degrees Fahrenheit. The diameter of the test piece was 0.994 inch. It showed an elastic limit of 240,800 pounds, with modulus of elasticity 29,220,000, and broke under a deflection at the middle of 0.744 inch. It is apparent that the allowable limits of specifications for finished springs are rising at a very rapid rate, and what the immediate future will bring can only be conjectured. In practice, however, the elastic limit actually necessary is very far below the extreme figures just cited. For special alloy steels the chemical composition varies widely, particularly in relation to the carbon and manganese contents, which may range considerably lower.

Tool Steel

On the subject of tool steel so much has been said and written of late, and there is so great a variation of judgment, that it would be profitless to add to the discussion here. Attention, therefore, will merely be called to certain tendencies in practice and to the results of a few typical tests.

In the writer's opinion there has been no more important development in this field than the recent movement fostered both by government construction officials and by large machinery builders for the standardization of tool steels. A report of the present attitude of the former is given on page 180, Part 2, Volume 32, of the American Machinist as well as the very interesting paper by J. M. Drake, on page 189 of the same issue, in relation to the practice determined upon by the General Electric Company. Both of these show clearly the present tendencies.

O. M. Becker, writing in the *Engineering Magazine*, states some facts of interest in relation to four grades of self-hardening tungsten steels which did not soften below 1020 degrees Fahren-

SOME SPECIFICATIONS FOR STEEL THAT ILLUSTRATE RECENT TENDENCIES—BY C. A. TUPPER.

Class of Steel and Where Used. Customary Heat Treatment Understood.	Physical Properties.				Percentage of Ingredients.							Remarks.
	Tensile Strength, Pounds per Square Inch.	Elastic Limit, Pounds per Square Inch.	Elongation, Per Cent. in 2 Inches.	Reduction in Area in Per Cent.	Carbon.	Manganese.	Phosphorus.	Sulphur.	Nickel.	Chromium.	Vanadium.	
Forgings for direct-acting pumps and compressors	55–60,000	30–40,000	22–28	35–45	0.25–0.33	0.48–0.50	0.03–0.07	0.03–0.05				General service.
Forgings for ordinary shop machinery	55–60,000	30–40,000	20–27	33–49	0.15–0.25	0.30–0.40	0.04–0.08	0.05–0.06				Where service varies but little with no unusual strains.
Heavy crank forging	79,000	58,000	32	62	0.29	0.53	0.05	0.05	3.2			Test of one crank.
Gears, continual mesh	50–60,000	34–42,000	40–44	58–62	0.30–0.35	0.45–0.49	0.03–0.05	0.03–0.04				Requirements vary widely with uses. Some automobile gears
Gears, sliding	55–60,000	42–45,000	43–48	65–72	0.20–0.23	0.24–0.32	0.04–0.05	0.02–0.03		0.30	0.12	show over three times the strength here given.
Cranks, shafts, axles, pins, webs, rods, etc	60–70,000	35–50,000	23–38	32–47	0.28–0.35	0.45–0.58	†0.05	0.04–0.05				Ordinary practice for moderate service. Tendency toward alloy steels.
Shaft and axles for heavy duty	80–85,000	55–65,000	25–30	34–40	0.32–0.36	0.45–0.60	0.04–0.06	0.04–0.05				
Heavy shafts and high-speed rotating parts	65–70,000	35–45,000	25–28	40–43	0.30–0.38	0.47–0.60	0.04–0.05	0.03–0.04				
Propeller shafts and rotating parts of hydraulic machinery subject to vibratory strains	85–100,000	60–70,000	31–39	43–48	0.31–0.37	0.44–0.52	0.03–0.04	0.01–0.03	3.25	1.00		For heaviest and most severe service. Tendency is toward use of special steels of extreme toughness and resistance to fatigue.
Armature shaft for large dynamo	90–105,000	65–80,000	36–41	66–72	0.43–0.48	0.49–0.56	†0.04	†0.04		1.04	0.13	Test of one crank.
Automobile crank shaft	121,000	114,000	23	64	0.28	0.56	trace	trace				
Automobile axle	66,000	41,000	42	61	0.32	0.49	0.04	0.04		1.10	0.18	Test of one axle.
Combustion chamber, rifle barrel, etc.	135–160,000	100–120,000	15–18	37–44	0.45–0.48	0.89–0.90	†0.03	†0.03				
Heavy spindle of high-speed machine	85–110,000	55–75,000	25–34	40–48	0.26–0.30	0.28–0.36	†0.05	†0.04				One recent specification.
Shaft of turbine pump	75,000	37,500	22	32	0.27–0.29	0.49–0.51	†0.05	†0.05				Tendency toward higher grade steel; not found adequate expression.
Plunger, piston, connecting rod, etc., for light service	50–60,000	30–35,000	28–30	38–45	0.25–0.36	0.38–0.50	0.04–0.05	0.03–0.05				Tendency toward special alloy steels.
Pistons and other parts working against pressure	80–85,000	45–50,000	22–30	38–42	0.26–0.30	0.33–0.46	†0.05	0.03–0.04	3.25			Tendency toward special alloy steels.
Crank pins for moderately severe service	70–75,000	40–52,000	24–27	32–39	0.45–0.53	0.58–0.62	0.04–0.05	0.03–0.04				
Crank pin for rolling-mill engine	110–125,000	90–100,000	25–33	42–48	0.27–0.35	0.33–0.39	†0.03	0.01–0.03		1.10	0.16	
Crosshead and crosshead pins	60–70,000	35–40,000	21–34	28–37	0.35–0.56	0.62–0.70	0.04–0.05	0.04–0.05				
End shields of very high speed rotors	105–120,000	80–100,000	18–22	33–37	0.34–0.36	0.50–0.55	†0.04	†0.03		0.95	0.15	
Eye bars of ordinary carbon steel	70–75,000	38–46,000	in 8″ 12–38		0.27–0.50	0.50–0.70	0.05–0.07	0.05–0.06				
Eye bars of nickel steel	85–100,000	*48,000	in 10′ *10		0.45	0.70			3.25			Specifications for St. Louis municipal bridge over Mississippi River.
Rivets for boilers and tanks	45–50,000	23–27,000	in 8″ 30–34		0.10–0.18	0.20–0.25	0.05–0.08	0.05–0.07				Rivets such as are carried in stock.
Rivets for bridge and structural work	55–60,000	28–33,000	32–36		0.11–0.16	0.22–0.28	0.04–0.08	0.03–0.07				
Structural steel for buildings	55–65,000	30–35,000	in 8″ 21–25		0.28–0.45	0.50–0.60	0.05–0.06	0.04–0.05				Common range.
Structural steel for ships and bridges	55–60,000	28–36,000	in 8″ 18–26		0.35–0.40	0.40–0.60	0.04–0.07	0.03–0.06				Not used much in future for important work.
Bridge steel	62–70,000	37–40,000	in 8″ 22–27		0.25–0.43	0.48–0.55	†0.04	†0.04				Recent specifications representing good modern practice.
Crane steel	65–70,000	33–36,000	in 8″ 21–23		0.24–0.26	0.45–0.48	†0.06	†0.04				Average specifications of a leading crane builder.
Rolled plate and hammered plate	55–60,000	29–33,000	in 8″ 17–19	52–60	0.18–0.22	0.34–0.42	0.06–0.08	0.05–0.07				
Boiler plate	65–70,000	45–55,000	in 8″ 25–30	48–55	0.22–0.26	0.30–0.50	0.04–0.06	0.03–0.04				
Special acid-resisting parts for turbine pump	90–110,000	70–85,000	24–28	56–66	0.25–0.31	0.42–0.51	†0.05	†0.04	3.50	0.80	0.17	
Crucible-steel spring; oil tempered	187,000	183,000	14	50	0.40	0.77				1.22		Figures given by American Vanadium Co
Spring steel	237,500	227,100	10	35	0.48	0.90				1.25	0.18	Extreme test noted by the writer.
Vanadium tool steel	227,000	224,000	in 8″ 12	42	0.34	0.40				1.00	0.17	Extreme test noted by the writer.
Mild-steel castings; basic O. H	60–70,000	27–35,000	20–22	30–34	0.20–0.38	0.30–0.45	0.05–0.08	0.05–0.06				Concerning basic and acid open-hearth steel castings, see the explanation in the text of article accompanying this chart.
Mild-steel castings; acid O. H	*60,000	*30,000	*20	*25	0.20–0.30	0.50–0.65	†0.06	†0.05				
Medium-steel castings; basic O. H	70–85,000	33–38,000	18–21	28–32	0.40–0.45	0.45–0.55	0.04–0.06	0.03–0.06				
Medium-steel castings; acid O. H	*70,000	*35,000	*15	*20	0.30–0.40	0.55–0.70	†0.06	†0.05				
Hard-steel castings; basic O. H	80–110,000	45–50,000	12–15	18–30	0.40–0.55	0.60–0.78	0.05–0.07	0.04–0.06				
Hard-steel castings; acid O. H	*80,000	*40,000	*10	*15	0.40–0.50	0.60–0.75	†0.06	†0.05				
Vanadium-steel castings	*70,000	*40,000	*20	*30	0.20–0.25	0.45–0.50	†0.06	†0.05			0.20	Figures given by custom foundry.
Steel castings subject to vibrational stresses	69–75,000	34–35,000	17–23	35–47	0.27–0.28	0.63–0.69	†0.06	†0.05				Range of a series of tests.
Steel castings for variety of heavy service	62–78,000	33–41,000	16–24	33–49	0.31–0.34	0.62–0.71	†0.06	†0.05				Range of a series of 12 tests.
Steel castings for pumps	65,000	34,000	18	24	0.26	0.48	0.05	0.04				One specification.
Steel rails; heavy O. H. carbon	90–100,000	55–60,000	in 8″ 20–30	30–40	0.75–1.15	0.60–0.75	0.03–0.08	0.04–0.06				Averages of figures available; practice varies greatly.

*Not less than. †Not over. NOTE 1.—Elongation is in 2 inches except where given differently. Percentage of elongation generally adopted is 1,400,000, divided by the ultimate strength. This, however, varies with the chemical content and heat treatment. NOTE 2.—The figures here given relate particularly to basic open-hearth steel, except where specified. NOTE 3.—The silicon is not given owing to the rarity with which it is specified. NOTE 4.—The figures are intended to represent average practice, except where otherwise mentioned, and no rigid limits are intended.

heit and whose upper limit was about 1300 degrees Fahrenheit. For these the following composition was given:

	Carbon.	Tungsten.	Molybdenum.	Chromium.	Manganese.	Silicon.	Sulphur.	Phosphorus.
A	2.150	5.441	.....	0.398	1.578	1.044		
B	1.615	.....	4.580	3.430	1.650	0.285	0.016	0.027
C	1.750	10.00	.....	1.00	1.750	0.060		
D	1.812	11.58	.....	2.694	2.430	0.89	0.007	0.023

In a test of vanadium steel the elastic limit was 222,200 pounds per square inch and it approached very closely the ultimate strength of 227,300 pounds per square inch.

The metal had an elongation of 11.5 per cent. in 8 inches and a reduction of 42 per cent. Its chemical content was carbon, 0.34 per cent.; sulphur, 0.025 per cent.; phosphorus, 0.027 per cent.; manganese, 0.40 per cent.; chromium 1 per cent. and vanadium 0.17 per cent.

High-speed Steel

High-speed steels are usually low in carbon, rarely exceeding 0.7 or 0.8 per cent. These steels made with the addition of chromium or tungsten, have the advantage over other high-speed steels in that it is easier to give them the proper heat treatment.

As showing the difference between the so-called "high-speed" and "self-hardening" steels, the following chemical comparisons may be made.

	High Speed. Per Cent.	Self Hardening. Per Cent.
Carbon	0.3 to 1.3	1.0 to 2.5
Tungsten	14.0 to 25.0	4.5 to 12.0
Chromium	2.0 to 7.0	0.1 to 3.5
Manganese ...	0.03 to 0.3	0.08 to 3.5

Another authority states the following as the chemical analyses of two tool steels which made an extremely favorable showing under test. One was: carbon 0.682 per cent.; tungsten, 17.81 per cent.; chromium, 5.95 per cent.; vanadium, 0.32 per cent.; manganese, 0.07 per cent.; silicon, 0.049 per cent. The other gave: Carbon, 0.674 per cent.; tungsten, 18.19 per cent.; chromium, 5.47 per cent.; vanadium, 0.29 per cent.; manganese, 0.11 per cent.; silicon, 0.043 per cent.

Annealing

Heat treatment of steel in the shop—and there is nothing which will be more likely to influence specifications in future—comes under two heads: annealing and tempering. The former, only, will be considered here, and without further reference to tool steel, which is a subject quite by itself—too large to be more than mentioned in a review of this kind.

Until very recently, annealing has not been given by builders of high-speed or heavy machinery the attention it deserves, end even today the art is practised to a far less extent than the average reader of this paper probably supposes.

By the annealing of steel before it leaves the mills, a uniformity of structure is given to billets which does much to relieve or prevent subsequent internal strains; and re-annealing of ordinary carbon steels in the shop, after forging or machining, is, as a rule highly desirable, for the reason that, at each of the three periods of recalescence or "absorption" in heating and cooling (i.e. six periods both ways) an actual re-arrangement of the molecules takes place while an increase in temperature is temporarily arrested, and such disturbance as there may have been of the physical structure of the piece, tending to crystallization, gives way to a restoration of the desired conditions.

In annealing, furnaces especially designed for the purpose, and preferably gas-fired, should be provided. The too prevalent tendency among machinery builders who do their own forging, to use an ordinary forge fire in annealing, leads to some pernicious results—results which, nevertheless, have to be taken into account in the preparation of specifications.

Fig. 2. Effect of Hammer Forging

A slow raising of the temperature to the final point of recalescence, with careful observation by means of a pyrometer, and even slower cooling, are essential to good practice.

Crystalline Fracture

Chemical analysis, which originally met with so much opposition when introduced in metal-working plants, has been swung to the other extreme, so much so that undue reliance has, of late, been placed upon it in many quarters. Chemistry, properly applied, is, of course, essential in determining the characteristics of steel; but it does not take the place of physical tests, and microscopic, or photo-microscopic apparatus will determine things that are altogether outside the range of chemistry.

In testing, the appearance of a crystalline fracture, or any trace of crystallization, should be sufficient to at once cause the rejection of a forging, if annealed steel is required; but for unannealed forgings crystalline fractures may be regarded as normal if the steel is high in carbon. A circumstance to be here observed, and one often overlooked by machinery builders, is the fact that forgings made in custom shops will not be annealed in advance unless annealing is specified; also that they will not be physically tested unless such tests are asked for or they are purchased under definite physical specifications. In testing, a bar is ordinarily severed from an end having the full diameter of the forging, the cut being made in an axial direction about half way of the radius, according to the U. S. naval standard.

Hydraulic Press Forgings

Since the development of the so-called "high-speed" press, the forging of steel by means of continuous hydraulic pressure, rather than by the use of a steam hammer, has been coming more and more into favor among builders of machinery subjected to severe stresses, for the reason that it results in a more uniform, homogeneous and reliable product.

No matter how powerful a steam hammer may be, the force of its blow is not ordinarily felt very far below the surface of a forging, and, even with the exercise of the greatest skill, the depth of compression forms a very irregular line around the center of the piece, leaving the interior far from solidified; whereas, with a press, the molecular structure of the forging is almost uniformly condensed, the compression being felt through its diameter. The press will also work very close to a shoulder, or even forge a squared up shoulder, thereby saving metal and time in machining.

These facts are becoming so well recognized that the day of the large steam hammer in this country, as in Europe, is drawing to a close; henceforth, for heavy work, presses will be quite generally installed as new equipment is needed. They are mentioned here particularly on account of the influence which they are beginning to exert on specifications.

One of the effects, which does not come under any of the other headings treated in this article, is a reduction (for pressed forgings) of 40 to 50 per cent. in the area of the initial section as compared with that which must be specified for hammered forgings.

Steel that has been forged by pressure and subsequently annealed shows greater homogeneity than hammered forgings and greater elongation. It also has greater toughness, offers more resistance to all manner of strains and has a higher elastic limit.

The effect of hammer forging is shown in Figs. 2, 3 and 4. In Fig. 2 the com-

paratively large area that is unaffected by the steam hammer and the unequal effect of the blows on the mass of metal is plainly shown. The lack of homogeniety in structure; the segregation of ferrite, pearlite and cementite, and the crystallization in spots can also be seen. This forging was made of high-carbon steel in a small shop without proper heat-treatment and this exaggerates the defects, but they are typical of what may occur in other places where a hammer is used.

In Fig. 3 are also shown the same defects from hammer forging as well as

FIG. 3. SAMPLE OF HAMMER FORGING

from uneven cooling a high-carbon steel. It also shows the method of obtaining drillings for chemical analysis.

In Fig. 4 will be seen a high-carbon steel shaft that was forged with a relatively light hammer. In this the effect of the blows can be seen and also the structural defects that might have been remedied by the proper heat-treatment.

STEEL CASTINGS

General steel castings may, for the purpose of convenient comparison, be considered under the old classification of "mild," "medium" or "hard." It would be futile in an article of this kind to make extended reference to so large a subject; but in the accompanying table will be found a number of interesting comparisons. The figures for basic open-hearth steel castings, under the general classification mentioned, were derived from a great variety of sources and show approximately the present average range. For acid open-hearth steel, however, the writer has used figures which are practically as submitted by the manager of a leading custom foundry, for the reason that they represent very fairly the best modern practice. In giving these figures the official referred to said: "We do not favor a maximum limit in specifications governing physical characteristics of steel, as if the minimum tensile strength, elastic limit, elongation and reduction of area specified are in proper relation to each other and the minimum, or better, in each characteristic is maintained, good results are bound to be obtained."

This view agrees substantially with that of most users of steel and specifications are usually drawn on that basis; but in any general consideration of the subject it is necessary to take into account averages of tests and ranges between minima and maxima in order to gain an understanding of prevailing tendencies.

The figures for vanadium-steel castings given in the table were also obtained from custom foundries.*

A feature to which especial attention may be directed is the close agreement between the figures given for steel castings for heavy duty as shown by the two lines of the table immediately preceding Crane Steel. These are noteworthy for the reason that each represents averages from quite a number of tests of castings intended for considerable variety of service.

It may be stated here also that, in all cases, permissible variations in the chemical analysis of steel, no matter for what purpose intended, should be given—rather than insisting upon strict adherence to the figures of a single analysis that is considered favorable; as it is practically necessary for the steel manufacturer to have a certain amount of leeway in either direction. "We have learned," says the superintendent of one prominent crucible-steel plant, "that a chemical specification that permits of no leeway has usually been prepared by a novice. Our experience shows that if a specification comes in with carbon 0.20 per cent., manganese 0.35 per cent., etc., it will do just as well if we fill the order with carbon 0.19 or 0.21 per cent. If we had no range to work on we would have to go out of the business."

The point made is a good one and it is recognized by practically all users of steel; at the same time the exercise of too great latitude in such matters should be very carefully guarded against; and the proper relation both of chemical conditions and physical characteristics ought to be rigidly insisted upon where the character of the service demands it.

STEEL RAILS

The subject of steel rails has been threshed out to such an extent, within the past two or three years, and judgments vary so greatly, that it is hardly profitable to discuss the matter here. Nevertheless, the experiments and tests recently made are having an important influence upon the entire steel question, and it will well repay machinery builders to devote some time to their observation. The best authorities seem to be agreed that for heavy rails a tensile strength of over 100,000 pounds should be demanded with elastic limit above 55,000 pounds and elongation of at least 20 per cent. in 8 inches. Chemical requirements, however, are widely at variance, ranging as follows: carbon 0.05 to 0.70 per cent.; phosphorus within 0.04 to 0.10 per cent.; silicon 0.15 to 0.40 per cent.; sulphur not over 0.06 per cent.; manganese 0.10 to 0.90 per cent.

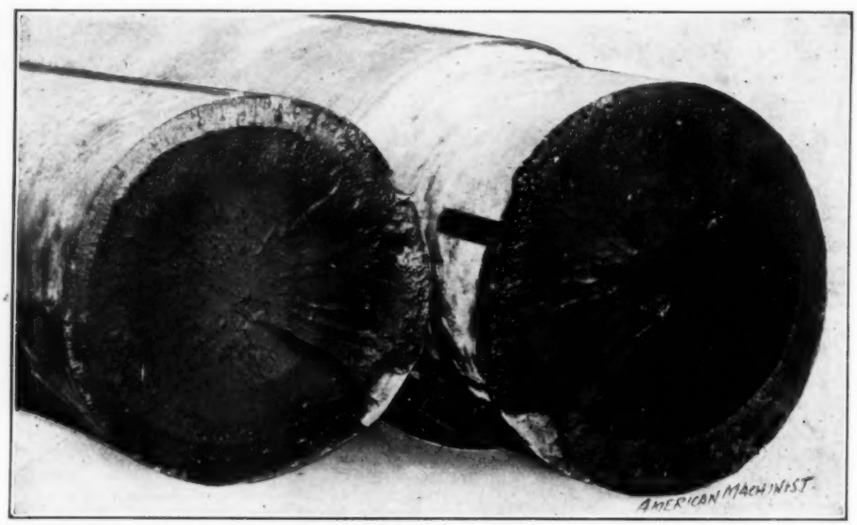


FIG. 4. PIECE FORGED WITH RELATIVELY LIGHT HAMMER

From this it is apparent that there can be no value whatever in generalities, and each test, experiment or conclusion reported should have separate consideration.

In the above connection it is of interest to note that the New York Central Railroad has been trying out a new steel known as titanium, an analysis of which shows carbon 0.45 per cent.; manganese 0.96 per cent.; silicon 0.13 per cent.; and phosphorus 0.095 per cent. These rails are characterized by a decided increase in strength over those previously used, and the percentage of split heads has been so greatly reduced that during 1908 there were only 25 such cases reported on all

*As the figures given in the table have much suggestive value and are in convenient form for comparison the author would appreciate any criticisms or suggestions.

the sections where this class of steel rail is used. It seems to be able to stand the extreme cold weather very well. Tests made on the Baltimore & Ohio Railroad since October 7, 1908, also show an increase in durability for titanium rails, of more than 300 per cent. over standard bessemer rails, confirming the results on the New York Central lines above referred to.

Bridge Steel

In their specifications for bridge steel, some of the leading construction engineers now demand a tensile strength of 62,000 to 70,000 pounds per square inch, with elastic limit considerably more than half, viz: not less than 37,000 to 40,000 pounds and elongation of 0.22 per cent. in 8 inches. All such steel is now generally required to be made by the open-hearth process, with allowance for 0.04 per cent. sulphur and 0.04 per cent. phosphorus in basic and 0.08 per cent. sulphur and 0.06 per cent. phosphorus in acid open-hearth steel, this being in line with the recommendation of the American Society for Testing Materials for a reduction in the last named from 0.08 to 0.06 per cent. The carbon content should not be less than 0.22 per cent. and preferably a third to three-quarters higher, with manganese about 0.55 per cent. these characteristics varying with the methods used in rolling and fabricating the material. For cold-bending tests requirements heretofore have been sufficiently large to apparently need no change.

The higher characteristics now made possible in bridge steel are not only the result of the demands of structural engineers but also of the success of steel makers in gradually, of their own initiative, perfecting their product. Formerly it was considered by many dangerous to use bridge steel having an ultimate tensile strength much above 60,000 pounds, for the reason that the carbon and phosphorus contents were largely localized, or segregated in hard spots, thereby decreasing the homogeneity and weakening the cohesiveness of the metal; but modern methods of mixing, soaking and rolling have resulted in an evenness of texture that practically eliminates the difficulty mentioned. Hence tendencies in bridge-steel specifications are more nearly approximating those of similar metal used for other purposes.

Structural Steel

For the structural steel plates, channels, beams, etc., used in buildings and hammered or rolled steel for ships, the tendency seems to be to require a tensile strength of no more than 55,000 to 60,000 pounds, with 70,000 pounds as a rather extreme limit, apart from some exceptional cases where it may range considerably higher, and the elastic limit specified is almost invariably "not less than half." A ductility, however, nearly or quite equal to that of high-grade machinery steel is generally demanded, the prevailing standard being an elongation of about 25 per cent. in 8 inches. Such steel may be made by either the open-hearth or bessemer process, but the former has considerable lead in the preference of most users.

Rivets made of low-carbon steel have an ultimate tensile strength somewhat lower than that of the structural steel with which they are used, with, of course, greater ductility, elongation of test bars (in 8 inches) of 32 to 36 per cent. now being frequently specified. Finished rivets must "be capable of being flattened out cold under the hammer to a thickness of one-half the diameter (or less) and of being flattened out hot to a thickness of one-third the diameter without showing cracks or flaws." The statement often made, that the safest steel rivets are those having low tensile strength, since they are the least liable to become hardened and fracture by hammering, or to break from repeated concussive and vibratory strains to which they are subjected in service, is not necessarily true. Indeed, it has come to be one of the triumphs of modern steel making to produce steel that not only possesses great tensile strength, with correspondingly high elastic limit, but is also very tough and ductile. Phosphorus and sulphur contents are kept as low as possible.

With respect to the last named points, however, it may not be unfitting to close this article by saying that the entire question of phosphorus and sulphur now seems to be regarded by the most progressive users of steel as little more than a "bugaboo," which, with the ghosts and hobgoblins of an earlier age, will soon be banished to the land of fearsome shadows. Proper methods of heat treatment are remedying, one after another, defects that have heretofore been ascribed almost solely to the presence in steel of the naughty chemical twins; and who knows but that in the very near future the frantic effort to reduce the proportions of phosphorus and sulphur to an almost irreducible minimum may be found to have been labor lost? Certainly, when that happy day arrives it will be a relief to the steel makers.

How I File My American Machinist

By C. W. Quast

I read with great interest G. H. Gibb's article. It brought back to my mind all the troubles I had to pass through in trying to keep articles of interest in a find-me-easy manner.

I commenced reading the American Machinist from its very first issue and have read every one since. I have received from no other periodical so much good and help in getting up the ladder as I have from the American Machinist. This, however, is nothing new, for ninety-nine out of a hundred will say the same thing and are proving it by the careful way they read and preserve it. What is required is an efficient and easy way to take care of all the good we find in it, not taking too much time to index or file, not too bulky and also to always have all the things one wishes to have, and nothing else.

With great interest have I followed up all the different systems which have appeared in the American Machinist and other papers, and yet none of them comes near to what the busy man wants and needs.

In the meantime I advanced in my position, from foreman to draftsman, chief draftsman, superintendent and at last manager. Of course, not in one place, for such is not our good luck. It meant a move each time, and each time I was confronted with more volumes, a greater pile of envelops and more loose pages and boxes. One periodical after another was added until now I am reading, not merely glancing over, during my little spare time four weekly (to which the *Maschinenbau* was added January 1), two semi-monthly and five monthly periodicals.

Six years ago, I finally decided to try a scheme which had been developing in my mind for a long time as a result of the troubles which I had encountered.

I bought two wooden letter-filing cases, with one drawer in each, each drawer measuring 13 inches wide by 11 inches high and 24 inches deep. I also bought 200 card-board folders for the drawers and a small address book of about 100 pages with an index running clear through excepting the last 10 pages.

This is the entire outfit. The card-board folders are numbered from 1 to 200 on the long side, and cut out in such a manner, that there remains a flap with the number standing out above the rest of the folders. The cutting is done in such a manner that there are 10 numbers in a row, one alongside of the other, the same as in a card index with numbers.

The little address book is my index proper. In it I made my entries, once only for each subject, both alphabetically and numerically in the following manner: On the tenth page of the book, be-

ginning at the back, I gave each line a number from 1 to 200, to represent each one of the folders. Having done this, I was ready to establish my index.

I took the first volume, containing nothing but what I wanted to keep, removed the cover. The first article happened to have the heading "Drawing Office System." This I wrote in the index book on the line with No. 1 and in the front of the book under *D*, I wrote on the first line "Drawing Office System" and placed 1 in front of it. Then I wrote the number 1 in the middle of the outside margin on all the pages belonging to the article and placed them in folder No. 1, which finished the operations for the first article.

The second article was "Power Testing of Machine Tools." This title I wrote in the back of the index book on the line marked with 2 and made the same entry in the front of the book under *P* on the first line, placing 2 in front of it, which denotes that No. 2 is for articles on that subject. After placing 2 in the middle of the outside margin of the pages belonging to this article, they were placed in folder No. 2.

The third article was "Automatics." This entry was made in the back of the book on the third line and in front of the book under *A* and placing 3 in front of it. The article was marked in the same manner as the others, with No. 3 and placed in folder No. 3. And so on, then came "Shop-bookkeeping," "Limit Gages," "Feed Water Heaters," "Condensers," "Oil-burners," "Refrigeration," etc.

Each new title received a new number in the back of the book and was entered under the respective letter in the front of the book, always setting the number under which it was entered, in front of it. Each title, or subject matter, received a folder and each folder has a number.

These are placed in numerical rotation in the filing drawers, the backs to the bottom and the numbers to the top by which a plain and easy method of filing is effected.

The indexing title is written but once in this system. If I want for reference, for instance, "Test on Bearings," I find in my little book under "T" 41 "Tests on Bearings," and consequently in folder No. 41 at the date which I possess on the subject in a compact convenient shape.

In the folders, the articles are assorted by pages or dates and journals, and each 50 pages are wired together, so that none of the pages will get lost or mixed up. The wiring forms little booklets, which are easily handled or relieved of obsolete material at any time.

The numbers which are written in the front margin of each page indicate at all times in which folder the bundle belongs. This system allows also a readjustment or subdividing of titles, without trouble.

If an article overlaps, that is when the end of an article is on one side of the leaf and the beginning of another article on the other side, the beginning is always placed with the new article. In such cases I write the subject number to which the finish belongs in large blue figures in the upper inner corner of that page, thus 3/ meaning that this conclusion belongs to an article in the folder No. 3. At the same time I mark the last page of the remaining article from which this page has been taken, in its lower inner corner with the subject number to which the conclusion of that article is to be found in folder No. 41. As all the pages have printed page numbers, the connection is always readily found.

Recently the AMERICAN MACHINIST has commenced to leave out the date from its pages.

In reading old data one always wishes to know how old they are. Sometimes the date is needed to make comparison or use the issue as a reference with other journals. I and all others who use the page-filing system or do not keep the front page, have to write the date on each page which we wish to keep.

This evil has been found by a number of readers here, and I trust that this mentioning will replace the dates where they are found in all the leading trade journals. It does cost almost nothing to have it there and it is certainly a great convenience to the thousands of readers.

Now I will give a little description of how I read and handle the above mentioned number of periodicals. I have an hour's train run to my place of duty every morning and an hour's return at night. I always have one or two journals with me. I read and mark every article of interest near the title and also in the middle of the outside margin of every page belonging to it. Once a month I take out all these marked pages, place them in rotation to page numbers and place in the middle of the outside margin the folder number where they belong. I have my little index book at hand, where I find the numbers belonging to each title by just opening it at the corresponding letter.

Should a new subject matter appear, which happens very seldom now, I take out a new number for it as described before, taking always the next number out of the back of the book and entering the title there as well as in front under its proper letter.

By the above system there is no hunting through a lot of volumes, all is together in one place and I have often taken three and even more subject matters to my office in my leather portfolio. Here I can divide and distribute them as the case may require.

The file cases have cost $5 and the folders 5 cents apiece, the little addressing or indexing book 50 cents, which is all the expense of having a good and always find-me-easy file in which I have at my finger points over 20,000 pages of interesting and valuable data, which it has taken over thirty years to collect.

Give it a trial and you will use nothing else.

Dimensions in Vulgar Fractions Again

By Con Wise

Anyone who does much drawing becomes weary of adding fractional dimensions. Anyone who uses drawings becomes weary of working to fractional dimensions. We are using vulgar fractions for dimensions not requiring extreme accuracy and decimals for those that we want right. When we get a line of dimensions across a drawing like this and want the overall length

$4\frac{1}{8}$ $7\frac{7}{16}$ $4\frac{3}{4}$ $9\frac{1}{2}$ $11\frac{1}{2}$

the natural thing is to put off doing it until the last and then be so weary that we make a mistake or two.

Now $\frac{1}{8}$ inch being the size of the tap drill for a ½-inch tap has a real meaning to a workman but $\frac{7}{64}$ or $\frac{1}{64}$ does not. That is, any man has to stop and think to know whether either one is half an inch or not.

I am beginning to write these demensions as follows:

$4\frac{8}{8}+\frac{1}{32}$ $7\frac{7}{16}+\frac{1}{64}$ $4\frac{32}{64}+\frac{1}{64}$ $9\frac{1}{2}+\frac{1}{32}$ $11\frac{8}{8}-\frac{1}{64}$

Adding whole number we get . 35

Adding first fraction of each set (mentally reducing to 16ths) . . . . . $\frac{80}{64}=1\frac{16}{64}$

Adding final fractions (algebraically) . . . . . $\frac{2}{32}=\frac{1}{16}$

35 and $1\frac{17}{64}$

Equals $36\frac{17}{64}$

We talked of writing all the first fractions in 16ths but it is very natural and easy to think of ½ as $\frac{8}{16}$ and ¾ as $\frac{12}{16}$ so there is no perceptible delay in leaving them in their natural form. The average mind comprehends $\frac{1}{32}$ or $\frac{1}{64}$ but when we express dimensions above ¼ inch in 64ths it takes a mind considerably above the average to quickly catch on; 32ds and 64ths can be as readily added either as 32d and a half or as two 64ths and one 64th as the 16ths can. All 32ds can be kept positive if desired, but it is better to write ½ inch — $\frac{1}{64}$ than $\frac{7}{16}+\frac{1}{32}+\frac{1}{64}$ and it is just as readily handled.

Try picking out $\frac{29}{64}$ on your scale and setting calipers to it and then set to $\frac{7}{16}+\frac{1}{64}$ and see if you don't agree with me.

Why Have Ball Bearings Been a Failure?

By E. J. Bacchle

The foregoing question has often been asked and my answer is usually the question: "Why have they been a success?" And ball bearings of the past have been a success over the plain bearing in the same sense as the ball bearings of today are a success over the ball bearings of the past. But that does not prove either ball bearings of the past or the plain bearing a failure.

Let us take the plain, the babbitt and bronze-bushed bearings; they are all a success within their limited speeds and loads. There are well established rules for the speed and load per square inch of projected area for these bearings. But with ball bearings little or no data of this kind were to be had in the past. Yet with all our lack of knowledge as to the quality of material required, the accuracy of workmanship necessary to produce a bearing that would roll with the least sliding action, the ball bearing of the past still made good under such rough usage and abuse as one would never dream of subjecting a plain bearing to. It was not until Professor Stribeck, of the Technical Laboratory of Neubabelsburg near Berlin, began his investigations and researches in the rolling and sliding action of balls and published the results, that a new era in the manufacture of ball bearings began. In his published results Professor Stribeck set forth these facts, to make ball bearings which will meet the requirements of today.

First: The material of the balls and races must be of uniform hardness throughout (not casehardened) and possess a toughness not usually found in ordinary steel; in fact it requires a special steel.

Second: The balls used in the bearing must all be of a uniform size, to prevent the load being carried by the largest ball, since the overloading of a single ball would soon destroy the surface of the ball as well as the races. Balls can now be had within 0.0001 inch to size, that go into the makeup of any one bearing.

Third: The races must be ground perfectly true to within 0.0001 inch.

Fourth: To obtain a perfect rolling and the least sliding contact, a two-point bearing is essential with the ball groove or track of the races in direct line of the load or pressure. This is clearly shown in Figure 1 for radial load and Figure 2 for thrust load.

Fifth: The load carrying capacity of the ball and bearing depends largely on the shape of the groove in the bearing. The radius of the groove is approximately nine-sixteenths of the ball diameter for radial bearing shown in Fig. 1 and two-thirds of the ball diameter for the radius of the groove for thrust bearing shown in Fig. 2.

Assuming that all types of bearings shown in the accompanying sketches are made of the required quality of steel, hardened throughout and the balls of uniform size, it will be well to point out some of the defects of the ball bearings of the past.

Referring to Fig. 3; this is of the four-point type of thrust bearing and when perfectly made has a rolling contact with a minimum of sliding. The ball makes contacts at points *A*, *B*, *C* and *D* with the sides of the races; the ball acting as a conical roller, indicated by the full lines inside of the ball circle. The difficulty, however, lies in the manufacturing of a bearing of this type accurately enough, for the contact side must be ground accurate to the proper calculated angle. In most cases the finished bearing will show up something like Fig. 4 with contact points *E*, *F*, *G* and *H* producing a conical roller that will set up all kinds of sliding action. This may be still further aggravated, should the upper plate happen to be grooved at different angles from the lower plate, a case not at all unlikely.

FIG. 1

CORRECT RADIAL BEARING

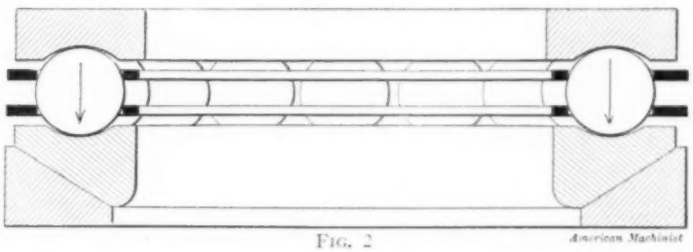


FIG. 2

CORRECT THRUST BEARING

Figure 5 shows a four-point radial bearing that can be ground with reasonable accuracy, but has one serious defect in that the inner race is in two parts to facilitate assembling of the balls and can be clamped together and produce an effect shown in Fig. 6. Friction and wear would also affect the outer race. This has not been indicated on the sketch in Fig. 6 and would produce a sliding effect to a certain degree and consequent wear.

Fig. 7 represents a three-point bearing producing a rolling action in perfectly true bearings. Should, however, the contact points *V* or *X* be ground at slightly different angles, thus changing the length of the radius *V* or *X*, it can be seen at once that this will introduce a sliding action.

In all the foregoing the load acts through the center line of the ball and would produce a rolling action in a bearing with the angles ground equal and true.

In Fig. 8 is shown the usual cup and cone of the old bicycle type. The load acting through the center at *J* trends to the right at 90 degrees, in one case at *K* and to the left at 45 degrees from the vertical at *I*, producing a most decided sliding action in several directions.

Fig. 9 is a two-point cup and cone bearing and has a rolling contact with the minimum of sliding, until wear in the bearing is developed and the usual adjustment of this type is taken advantage of. The bearing is then usually destroyed in short order by the pinching of the balls aginst the worn grooves, such as shown in Fig. 6. This also applies to Figs. 7 and 8.

In Fig. 9 the ball grooves must be ground in perfect alinement, as shown in this case, at an angle of 45 degrees through contact points *LM*. Should the inner race be ground a trifle large and the ball make contact somewhere between point *L* and the vertical center line, the pure rolling contact is destroyed and sliding introduced with aforesaid results. Even at best this bearing has only a permissible loading capacity approximately seven-tenths of the bearing in Fig. 1, using balls of the same diameter and quality. The loading is in the direction of the arrow on the ball and the resultant of the loads applied being in the direction *LM*1, while in Fig. 1 the load is applied in the same direction as the line of contact *Y Z* 1.

In Fig. 1 the faces can be ground very accurately and any variation easily detected. The two-point bearing of the annular type as shown in Fig. 1 fulfils all the conditions of rolling with the least sliding action of the balls and takes the load applied in direct line of the contact points of the balls and races. This is also applicable to Fig. 2 where the

limitations of speeds are well within the limits of the centrifugal force tending to throw the balls outward, thus preventing wedging action and consequent sliding. This is approximately at 1500 revolutions per minute where the pitch diameter of the ball track is not more than six times the ball diameter.

Back in the Eighties and early Nineties when ball bearings became fashionable, so to speak, they were used chiefly in the bicycle. We all had our trials with them; that is the old veterans of the wheel, with broken balls and worn races of the so-called adjustable bearing, as shown in Figs. 8 and 9; the old cup-and-cone type. But never adjustable unless the pinching of the ball in the ball races was considered an adjustment. It was my first experience with ball bearings and I formed the opinion then that holds good today, that an adjustable ball bearing is yet to be invented. Did we consider ball bearings a failure in those days? Ask any old wheelman and he will tell you of the century runs he has made and how the bearings stood up under the test. What if they did grind out when the sand and grit mixed with the oil; did we not have a dustprooof felt washer the next year in our new model? Another genius invented the separator for the following year's model and we had the acme of perfection in ball bearings, even though they were made of machine steel and case-hardened or of the best of tool steel. Of course the duties were light compared with the loads and lasting qualities expected of the ball bearing of today, in the automobile and machine tools.

With the automobile came Professor Stribeck's researches and the ball bearing of today—the annular bearing and the balled seated thrust bearing with carrying capacity from 100 pounds to 20,000 pounds for a single bearing and speeds to 1500 and even 2000 revolutions per minute for thrust bearings and 5000 to 15,000 revolutions per minute for radial bearings. These are tested out and tried by the DWF of Germany and the Hess-Bright Manufacturing Company of the United States, at their works, where they both conduct a large testing laboratory, checking each other's results to the one end; to produce a reliable bearing of known capacity, with the minimum of friction or sliding action; a bearing made of steel of uniform hardness throughout, ground to within limits of 0.0001 inch and balls of uniform diameter selected to within 0.0001 inch for each and every bearing.

What have been the experiences of the past are but stepping stones to success.

Alloy of Copper and Iron

Copper-iron alloys are receiving the attention of metallurgists, and from the results of tests made with such alloys, they do not seem to be much behind nickel steel. An alloy containing 0.1 per cent. of copper disclosed a yielding point of 52,580 pounds per square inch, while a 7 per cent. copper alloy showed 122,900 pounds per square inch. These were the results obtained from tests with unannealed alloy, while specimens annealed showed a yielding point at 35,570 pounds for the 1 per cent. alloy and 56,950 pounds for the 7 per cent. specimen. The physical properties of such an alloy are thus very promising, as the small percentage of copper required brings the cost down considerably as compared with nickel.

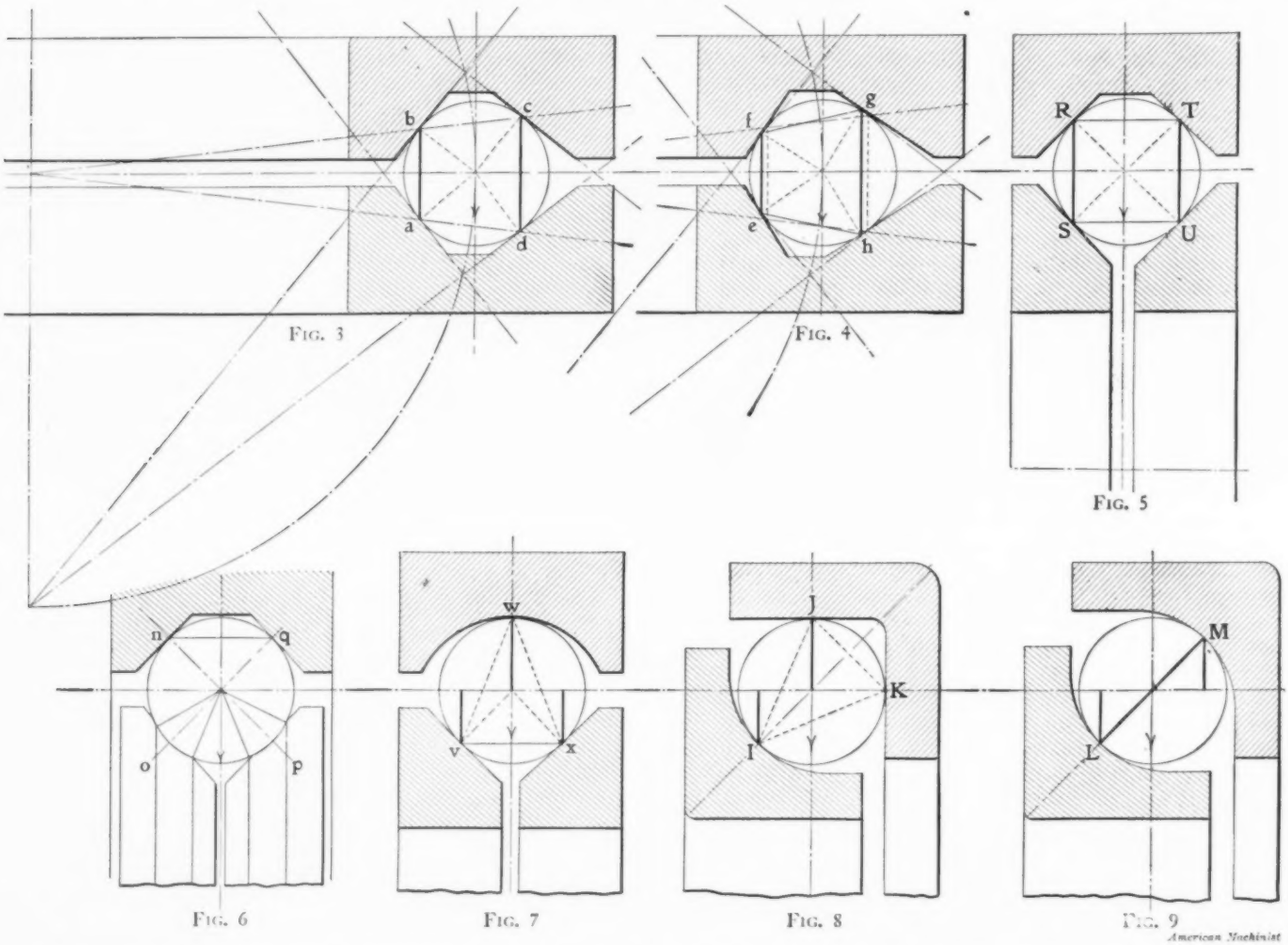


FIG. 3 FIG. 4 FIG. 5

FIG. 6 FIG. 7 FIG. 8 FIG. 9

American Machinist

Fig. 3. Four-point thrust bearing accurately ground. Fig. 4. Same bearing incorrectly ground, showing rubbing. Fig. 5. Four-point radial bearing correctly ground and adjusted. Fig. 6. Effect of wear on Fig. 5, producing rubbing. Fig. 7. Three-point radial bearing subject to defect shown in Fig. 6. Fig. 8. Old-style bicycle bearing showing rubbing due to faulty design. Fig. 9. Bicycle bearing without rubbing action until worn.

Special Machines for Making Large Spherical Bearings

The Boring Bars and Other Tools Used in Handling This Work

By Robert Reid

The bearings which are the subject of this article were made for a 6000 horsepower induction motor for the new steel works of the United States Steel Corporation at Gary, Indiana. The shaft was designed to run at 75 revolutions per minute. They are of the ball-bearing type and are the largest of the kind that the General Electric Company has ever made, notwithstanding the fact that they have built some of the largest motors that are in existence. This makes the machining operation described below of special interest, and some of the special rigging and tools that were required can be practically applied to other classes of work.

The journal of the bearings varies from 24 to 30 inches in diameter and from 60 to 72 inches in length, or from 5 to 6 feet: the balls ranging from 40 to 60 inches in diameter. The largest, with the standard and cap, have a shipping weight of about 64,000 pounds or 32 tons. The standards for these bearings are about 12 feet long, 6½ feet wide and 5 feet high to the joint where the cap goes on. The bearings are of cast iron, with two or more shoulders turned on the outside to fit the ends of the different standards. It requires 2400 pounds of babbitt to pour each bearing; 1200 pounds being required for each half. They are held in place by being bolted to the ends of the standard.

The first operation on the bearing is to rough bore them to a diameter that is about one inch larger than the finished size. Next circular and longitudinal dovetail grooves are machined in them to hold the babbitt in place, and they are then transferred to the brass foundry, where they are babbitted. The babbitt is melted in Schwartz furnaces and a half-round boiler-plate arbor is used when pouring it. A liberal finish is allowed for boring in order that a good clean surface may be obtained. This method

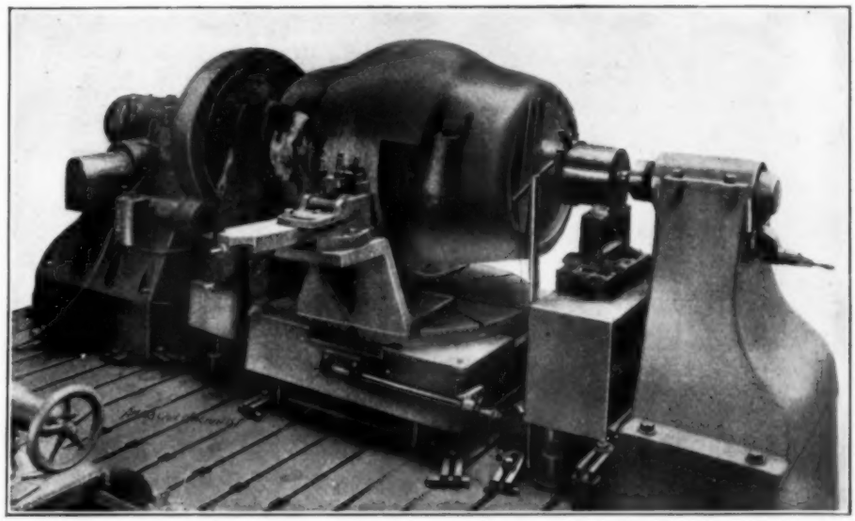


FIG. 2. MACHINE ASSEMBLED ON FLOOR PLATE FROM PARTS OF OTHER MACHINES

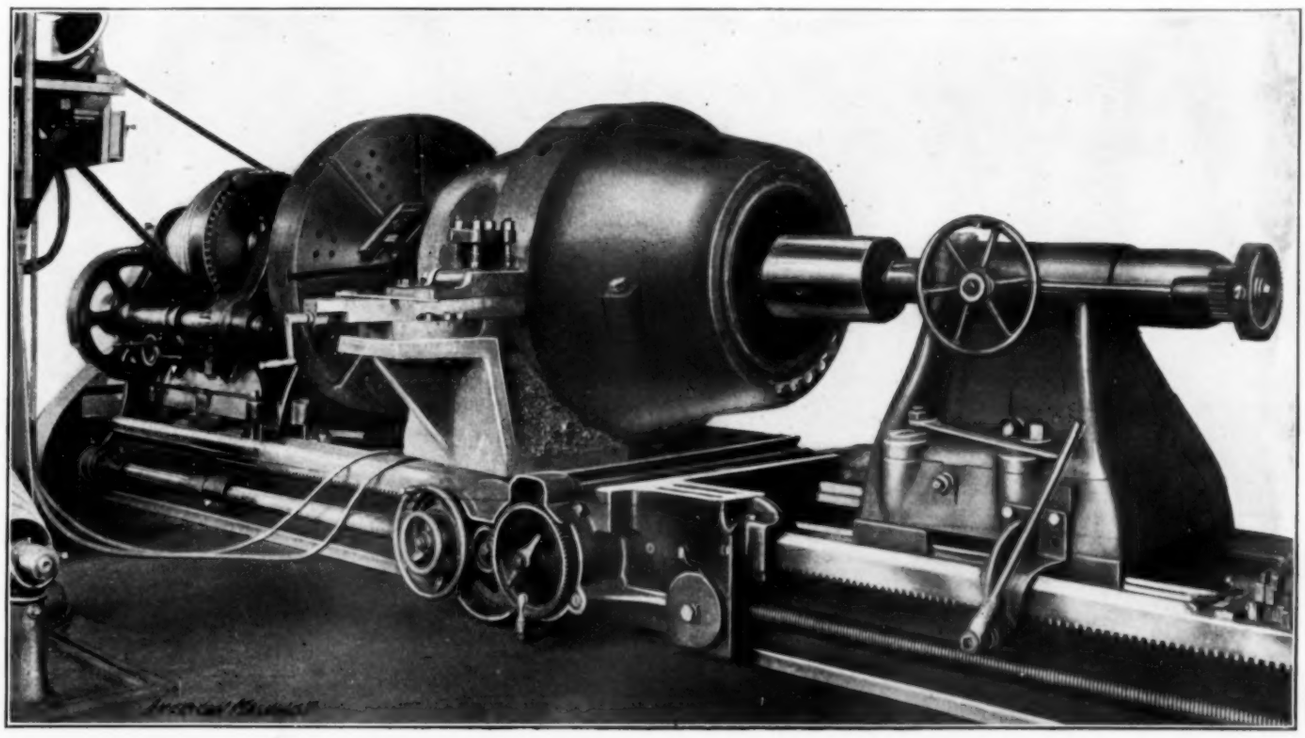


FIG. 1. ROUGH TURNING BEARINGS TO OUTSIDE DIAMETER

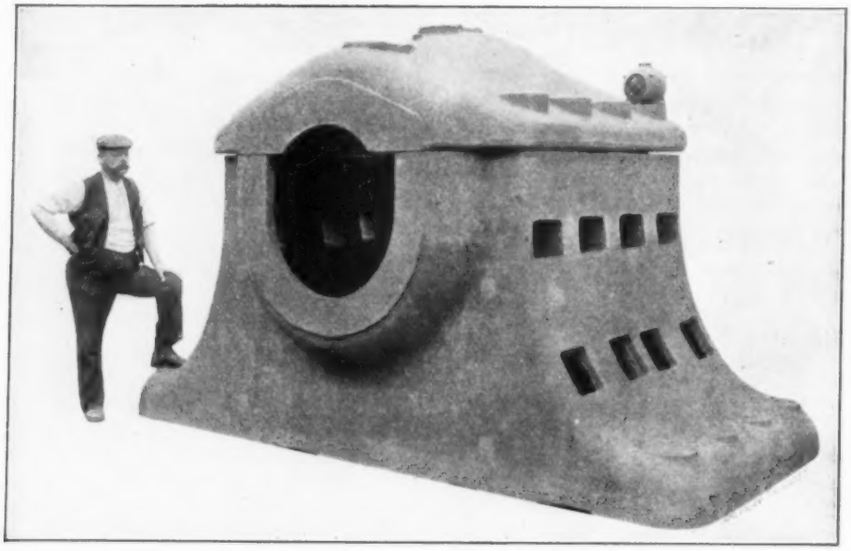


FIG. 3. PEDESTAL OF 6000-HORSEPOWER INDUCTION MOTOR FOR STEEL PLANT AT GARY, INDIANA

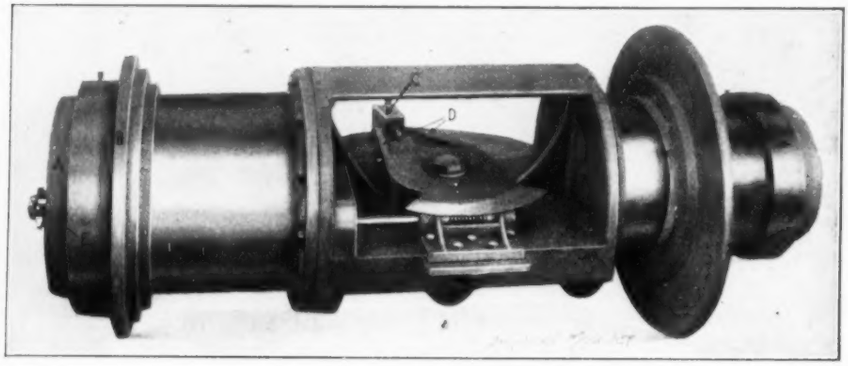


FIG. 4. BAR WHICH TURNS BALL FOR PEDESTAL AND CAP

insures a uniform thickness of babbitt thoroughly secured in place.

The joints are then planed, after which the two halves are bolted together, and they are bored to the required diameter on a horizontal boring machine. Next, they are mounted on an arbor and placed in a 72-inch lathe, where the ends are faced off and the center turned to a size that equals the largest diameter of the ball, as shown in Fig. 1. The center line of the ball is marked off on this surface, and the bearing is then taken to the balling machine, where it is set up by means of this center line.

As the machines are not of a standard type, special apparatus had to be devised for turning the ball shape on the bearings, and the machine shown in Fig. 2 was rigged up for this purpose. It consists of the head and tailstocks of two different machines that were located on the floor plate so their centers would come to the same hight, and these centers were made to carry the arbor with its bearing. As there was a possibility of these centers giving way, bearing blocks were placed at each end of the arbor to assist in carrying the load, and these were adjusted by means of screw jacks on the floor plate. A large index stand was fastened to the floor between the head and tailstock and on the table of this was mounted a large bracket to carry the slide of a planer head. This holds the tool and insures for it ample adjustment. The table is turned by means of a worm and gear operated by a special automatic feeding device, which is worthy of special attention.

This feeding device is shown at the

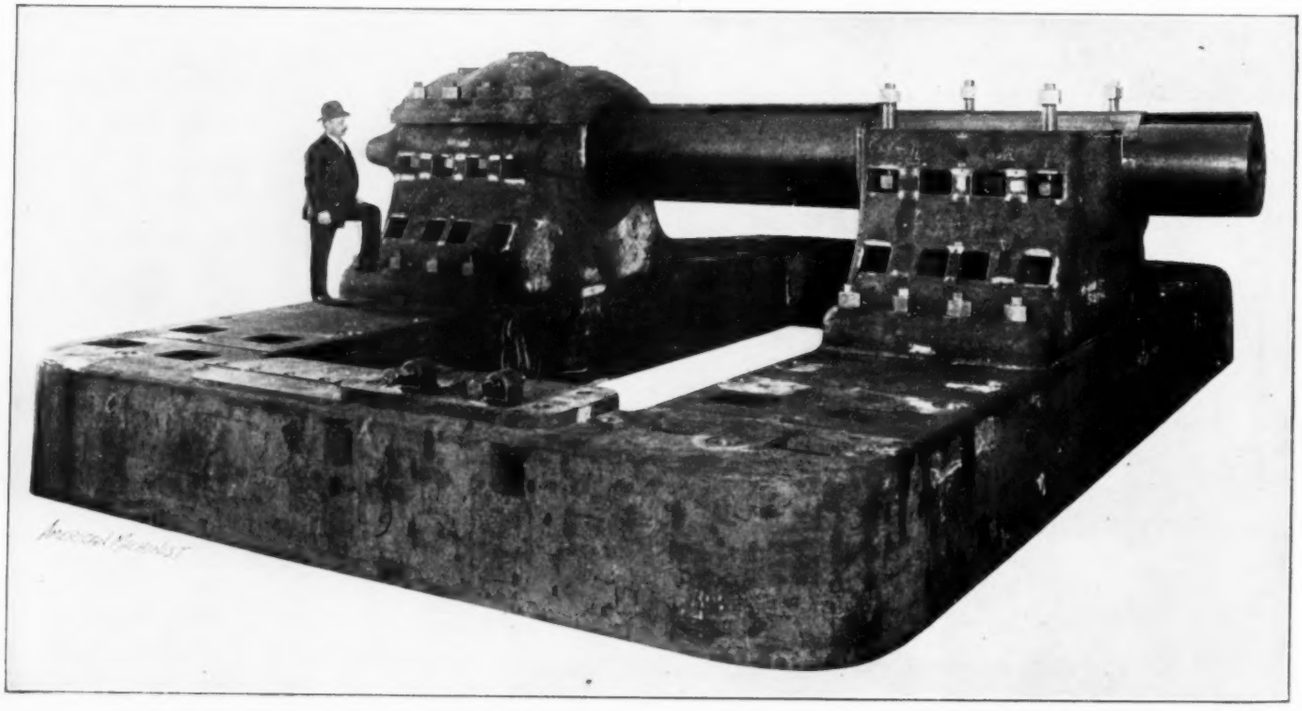


FIG. 5. 6000-HORSEPOWER INDUCTION MOTOR BASE WITH PEDESTAL, BEARING, CAP AND SHAFT ASSEMBLED

right of the bearing. It consists of a machined steel strap *A*, clamped to the arbor, which in rotating strikes the lever arm *B*, thus giving an upward movement to the light steel rod *C* and the ratchet lever *D*. This moves the ratchet, worm, worm wheel and table carrying the tools. When the strap *A* has passed by the lever *D*, it allows the ratchet lever *D* to return to its position by gravity.

When the operation of turning the ball has been completed, the bearing is then removed from the machine, taken apart and the final scraping and touching up is given, as in the case of smaller bearings.

This assembling together of the various parts into a machine of the character shown in Fig. 2, shows the great adaptability of the iron floor plate for large work of various types, as under no other conditions could this work be done with the same degree of accuracy.

The standard and cap for this bearing are shown in Fig. 3 as they come from the foundry. Its comparative size is shown by the man to the left, or by the complete quarter horsepower motor which sits on one of the cap-screw bosses. The first operation on the pedestal is to machine the bottom, after which the top is machined so the cap will fit on a 120-in. planer. The holes are then drilled to fasten the pedestal to the base, and the holes on the top are drilled and tapped for the cap screw. The cap is then planed to fit the pedestal, cap-screw holes drilled and counterbored and the cap bolted to the pedestal. After this the sides are machined and the center bored out to suit the balling bar shown in Fig. 4, which performs the next operation. This bar is made up of two cylindrical end sections and a central section that carries the radius arm *D* together with the worm and worm wheel used for turning the tool. By having several of these radius arms of different lengths, quite a range in size may be obtained. The bar shown here is able to ball out bearings for balls ranging from 40 to 60 inches in diameter. The radius arm is operated by means of the star wheel *E*, while the bar itself is rotated by means of a large spur gear mounted on the end of the bar at *A*, and driven by a pinion on the spindle of a large boring and drilling machine. The bearings on which the bar turns in the pedestal and cap are shown at *B* and the tool holder at *C*.

Some idea of the size of these bearings, etc., can be obtained from Fig. 5, in which the pedestal bearing, cap and shaft are assembled on the base of the 6000 horsepower induction motor.

Design of Pocket Sheaves for Cable Chain

*By A. W. Jenks**

It is frequently desired to design pocket sheaves, or as sometimes termed "sprocket" sheaves for cable chain and the method here described will be found convenient and exact. While the method is not claimed as original with me, it does not seem to be generally known among draftsmen.

Cable chain is either hand made or machine made. The machine made, which is the cheaper quality, will be found very accurate in pitch and shape of links. The hand made varies a little in pitch of links and the links will be found to vary considerably in shape, especially in the weld, which is at the end of the link.

When it is intended to use a hand-made chain with the pocket sheave, the sheave casting to be used is sent to the chainmaker who makes the chain "over" the wheel, fitting each link into place; thus making what is known as "hand-made wheel" chain. However, regardless of which chain is to be used, it is preferable to adopt for either, the sizes given in manufacturers' catalogs for machine-made chain, as the proportions of the links have been adopted after long experience in making and using chain. Should the chain be on hand, it is wise to measure over some 18 or 20 links and obtain an average pitch per link. Extreme accuracy must be used in all operations or your wheel will not turn out right.

The following example covers the design of a 10-tooth or 10-pocket sheave for 1-inch chain. The letters refer to the cuts. It is first necessary to obtain dimensions *A* and *B*. The chain catalog gives us length of link *W* for 1-inch chain, as 4¾ inches and width of link *w* as 3½ inches. From the length we find that $A = 3\frac{3}{4}$ inches and $B = 1\frac{3}{4}$ inches. The points *x x x* are actually the pin centers upon which the links revolve, when passing over the sheave.

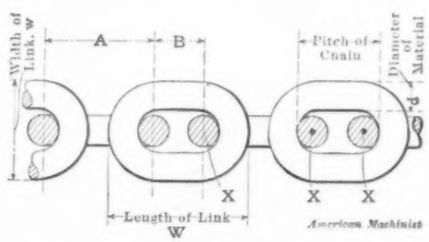


FIG. 1. DESIGN OF POCKET SHEAVES FOR CABLE CHAIN

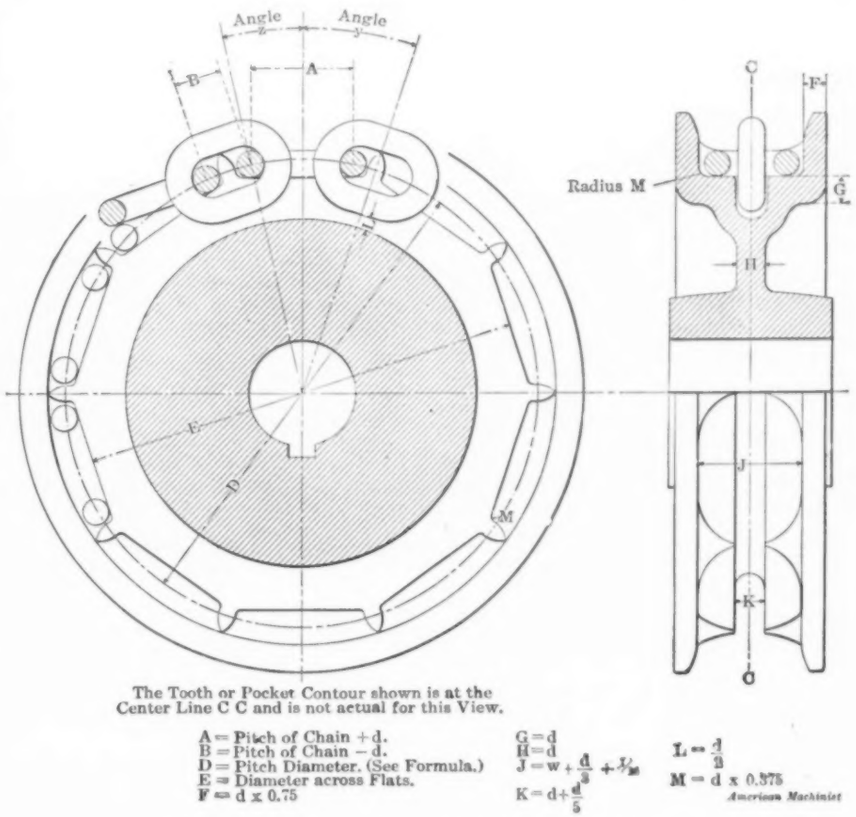


FIG. 2. DESIGN OF POCKET SHEAVES FOR CABLE CHAIN

*Chief engineer, Vulcan Iron Works, Chicago, Ill.

Our next step is to find the pitch diameter D, which passes through these points $x\,x\,x$. This is accomplished with the aid of formulas to be found in Brown & Sharpe Manufacturing Company's catalog, given there for bicycle chain but which fit our case precisely.

N = Number of teeth or number of pockets in whole wheel.

A = Distance, center to center of link length.

B = Distance, center to center between two links.

(In our example A and B are as given above, 3¾ inches and 1¼ inches.)

$$\text{Angle } y = \frac{180^\circ}{N}, \text{ or in our case} = \frac{180}{10} = 18 \text{ degrees.}$$

$$\text{Tangent of angle } z = \frac{sine\ y}{\frac{B}{A} + cosine\ y} = \frac{0.30902}{\frac{1.75}{3.75} + 0.95106} = 0.21797$$

The tangent 0.21797 corresponds to an angle of 12 degrees 17 minutes 46 seconds, the sine of which = 0.21297

$$\text{Pitch diameter} = \frac{A}{sine\ z} = \frac{3.75}{0.21297} = 17.6081 \text{ inches.}$$

It is advisable to use at least 5 decimal places in all quantities as the result is very greatly affected by their absence.

Having the pitch diameter, we can now proceed to lay out our wheel. It is desirable to make a full sized layout, if only for a check upon the computations.

Divide the circle into 10 parts for the 10 teeth. We need draw in but two or three links to obtain all necessary dimensions for the shape of the pocket. The horizontal chain link is a chord of 3¾ inches length on the pitch circle; the vertical link is a chord of 1¼ inches length. The axis of the vertical link passes through the centers $x\,x$ of the two adjacent horizontal links. The diameter across the flats E can now be measured and this is really the most important dimension on the wheel.

It would be wise, as a check, to space off alternate chords of 1¼ inches and 3¾ inches around the entire wheel. Of course, there should be 10 of each. The distance E can also be found by computing the cosine of angle z with radius = 8.80405 inches or half the calculated pitch diameter and deducting from the result ½ the diameter of the link material.

As the pockets are not to be machined, allow ample clearance; make the pocket at least ¼ inch longer than the link, which will leave the width of tooth at center line of wheel ½ inch. The groove in the center of the wheel which accommodates the vertical links, should be plenty wide and deep enough so that the links will fall into a natural position.

It must be noted that the tooth as drawn, is not the shape of the tooth at the side of the center groove but is the shape at the center line. The patternmaker will find it easier to work from this imaginary place, but explain with a note, so that he will not misunderstand. The shape of the tooth faces can be found by considering that each link lifts on its center x, until it comes in line with the next link, when the two lift on the second center, until in line with the third and so on. However, make the tooth somewhat thinner than the contour thus found, or it will be difficult to get the chain into the wheel.

Wheels are sometimes made with a pocket for the vertical link, but I prefer not to use them, as when the wheel becomes a little worn the vertical link has a tendency to pry the horizontal link from its bearing.

If you have designed the wheel as above and the patternmaker, coremaker and molder have each and all used care, the chain will conform to the following conditions: the horizontal links will lie down tight on to the flats of the pockets and the vertical links will be tight between the others. It is better that the chain be too tight than too loose, as some stretch will occur in the first few days of operation.

Do not neglect to use care in your computations; approximations will not do. I was once forced to throw away two 18-tooth wheels for 1¼-inch chain, simply because the customer had stated the pitch to be 4 inches, when actually it was 396 inches divided by 100 links or 3.96 inches pitch; a difference of only 4/100 inch per link and seemingly negligible, but which actually made a difference of 18x2x0.04, or about 1½ inches in the circumference of the wheel.

For a small wheel it is usual to make a full circle core box for half the wheel and paste the cores together. In a larger wheel the corebox may be only half of one-half of the wheel, four cores being pasted together to make the full core. See, however, that the coremaker uses special precautions when pasting the pieces together, so that the two halves of the pocket will not be offset.

Winding Coil Springs in a Lathe

By F. M. Springer

Where springs are coiled from wire in a quantity not great enough to pay for a special machine, or where the requirements are very exacting, the following two tools will be found of service.

In Fig. 1, A is an arbor held in the chuck of a speed lathe. C is the wire guide and also handle of the tool and carries the piece B to steady-rest the arbor. The wire is held in the lathe chuck by having a sharp turn made near the end, and being stuck into the chuck in the opening between the jaws. As the lathe is started, the wire forms a left-hand helix and feeds to the arbor through the path shown by the dot-and-dash line X and arrows, passing between B and C and under arbor A. The pitch of the spring is regulated by the thickness at E of the wire guide C where it partially incloses the arbor and separates the coils of the spring. C is beveled down at this point till by trial the pitch is found to be correct. Also the selection of an arbor must depend on trial as in winding springs on arbors in other ways. In fact, the arbor is the first thing to select and then make your tool.

As all conditions of winding are duplicated with considerable uniformity so long as the wire is fed freely from the coil, this device produces springs that will pass very close inspection.

If springs that are more exact as to pitch are required, the device shown in Fig. 2 is good.

The arbor A is chosen for size by trial

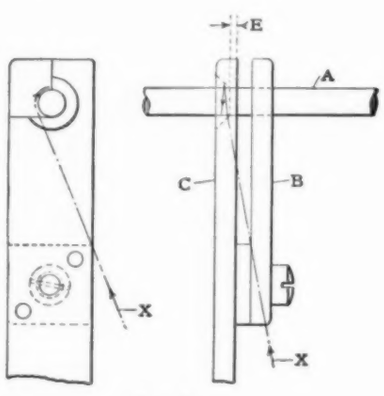


FIG. 1

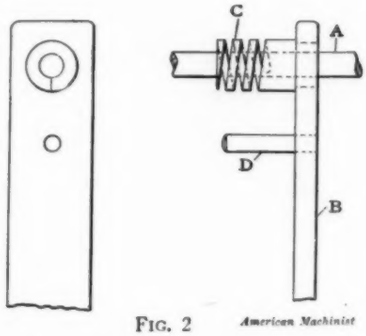


FIG. 2

ARBOR GUIDES FOR MAKING COIL SPRINGS

as in the case of Fig. 1. It is held in the chuck of a speed lathe as before, and the spring wire is also held as before described. The wire guide *C* is a tube in which is a hole fitting the arbor and having a helical milling cut taken, cutting entirely through the wall of the tube and leaving a hollow helix of metal exactly as though a square thread were cut in a rod and a drill of diameter equal to the bottom diameter of the thread were run in, leaving nothing but the thread. The wire guide *C* is mounted in a handle *B* in which is a pin *D* over which the wire passes to the groove in *C*. The groove in the wire guide should be only enough wider than the diameter of the wire to allow the latter to run easily; and the pitch of the helix must be found by trial.

As the helix may be either left or right hand and the wire may be passed either over or under the pin *D*, a tool may be as easily made for right-hand as for left-hand helical springs.

This tool requires more experimenting to determine the pitch of the helix which will set the wire for the required pitch, but is very satisfactory when finished.

In the case of both tools described, the arbor may be of any length, depending only upon the length of springs that it is most economical to handle before cutting up into the finished article.

Design and Construction of Four 9000 H. P. Turbines

Important Advance Showing an Increased Efficiency and Volume

By H. Birchard Taylor *

The four hydraulic turbines now being installed in the Little Falls plant of the Washington Water Power Company, on the Spokane river, Washington, are among the largest in the world. Each turbine is designed to have a capacity to deliver to the generator which it drives, 9000 mechanical horsepower when operating under a head of 66 feet and when running at a speed of 150 revolutions per minute. For these conditions of power and head, each turbine will require about 1500 cubic feet of water per second.

The largest turbines at Niagara Falls are the four 13,000 horsepower units in the plant of the Toronto Power Company, and each of these turbines requires about 1060 cubic feet of water per second. As the size of a turbine depends largely upon the amount of water it requires per second, it is to be noted that the Washington turbines are constructed to handle about 41.5 per cent. more water than the largest turbines at Niagara Falls.

Both the Washington and the Toronto turbines were designed and built by the I. P. Morris Company, Philadelphia, Penn.

*Assistant hydraulic engineer, I. P. Morris Company.

Power House Arrangement and Type of Turbines

Referring to illustration Fig. 1, the power-house arrangement, it is seen that the turbines are of the horizontal shaft, double-volute casing, central-discharge type, having two runners mounted on a common shaft, one runner revolving in each volute casing.

Each turbine is supplied with water through a plate-steel penstock 14 feet 10 inches diameter, which is connected to the two volute casings by a heavy cast-

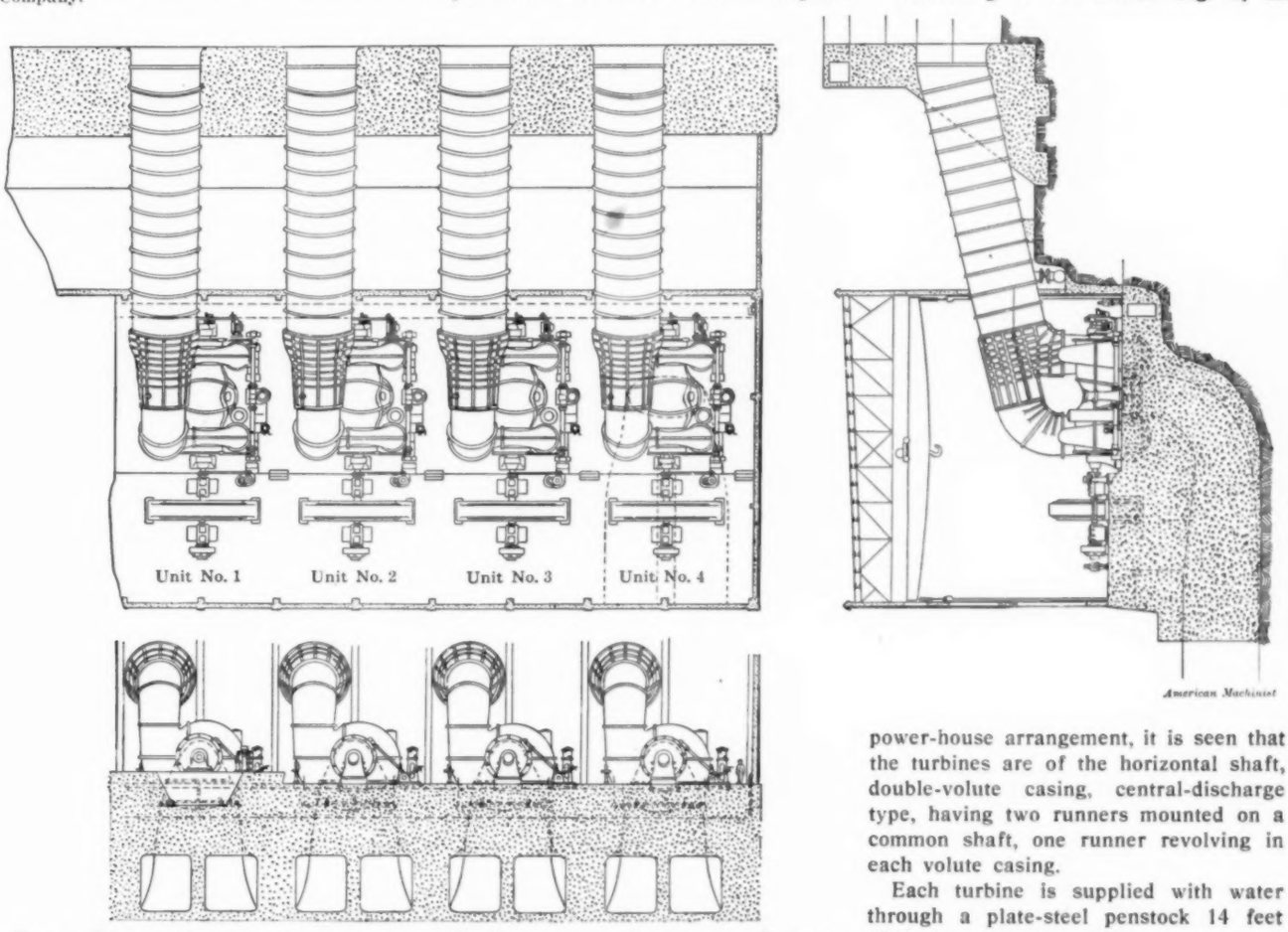


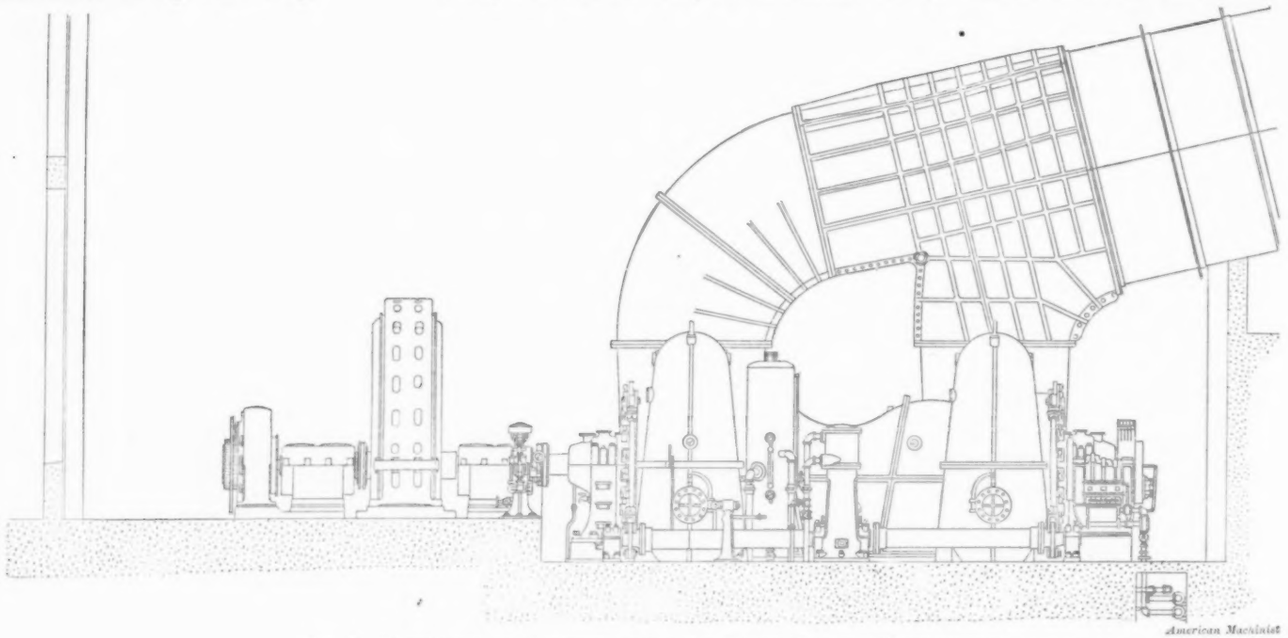
Fig. 1. Power House Arrangement of 9000-Horsepower Turbines at Little Falls, Washington

iron intake Y-pipe. The Y-pipe, which is located above the turbine, is supported on the two casings and to one side of the vertical plane which passes through the axis of the shaft. The intake Y-pipe is made of cast iron and in nine sections, and it connects the 14-foot 10-inch diameter penstock to the two 8-foot 10-inch diameter intakes of the two volute casings. The average velocity of the water as it passes from the penstock to the two casings is gradually accelerated from about 8.7 feet per second to 12.3 feet per second, the latter velocity being maintained through the casings.

which are located around the periphery of the runner and in the throat of the casing. The vanes turn between two cast-steel removable vane plates. Each vane has cast with it a fulcrum pin, which extends from both sides of the vane. The part of the pin on the draft-chest side of the vane is short in length and extends into a bearing in the cast-steel vane plate. The operating part of the pin, which is long, extends through a stuffing box and two bearings in the head plate. Therefore, each vane pin is held rigidly in alinement by three bearings. The operating side of the pin is connected

imbedded in the concrete. It is elliptical in shape and measures 12 feet 4 inches on its major axis and 9 feet 3 inches on its minor axis. The lower flange of the draft chest is supported on and securely bolted to the upper face of the ring.

The main turbine shaft revolves in two babbitted, ring-oiling, self-alining generator type bearings, one on either end of the shaft. Each bearing pedestal is mounted on a sub-base which in turn is mounted on a sole plate securely bolted to the concrete foundations. As the two runners discharge in opposite directions, the hydraulic thrust on the shaft is theo-



American Machinist

FIG. 2. ELEVATION OF TURBINE OF LITTLE FALLS PLANT, WASHINGTON

To facilitate handling and shipping, the cast-iron volute casings are each made in four sections, the divisions occurring on vertical and horizontal planes. The horizontal joint, which is in a plane passing through the axis of the shaft, measures 24 feet 8 inches across.

CONSTRUCTION

The main turbine shaft is a solid steel forging 36 feet 8½ inches in length, and passes through both casings and the draft chest, and on its inboard end has a forged coupling which is bolted to a similar coupling on the generator shaft. The diameter of the shaft is increased from both ends to a maximum at its center, so as to eliminate serious deflection at the center. A bearing at the center of the shaft is, therefore, not required.

The two runners are of the inward flow Francis type and each is a single casting of special turbine bronze. Each runner is securely held to a large hub forged on the shaft by means of taper reamed bolts. All vane surfaces are made smooth and the intake edges are sharpened to a knife edge.

The water is distributed to each runner through cast steel movable guide vanes by a cast-steel lever and a cast-iron link to the cast-steel operating ring, which turns in a groove in the head plate. This arrangement is known as the outside operating mechanism.

The operating ring on each head plate is connected by two reach rods to the main operating shaft, which extends along the side of the turbine and turns in four bearings secured to the floor. A bearing is located at each end of the operating shaft and the two other bearings are located close together, one on either side of the center of the shaft.

A heavy cast-steel lever is secured to the operating shaft between the two center bearings, and to this is attached the piston rod of the operating engine, which is controlled by the governor.

A cast-iron draft chest is located between the two volute casings and is made up of nine sections. It receives the discharge water from both runners and directs it vertically downward into the draft tube. A special cast-iron baffle plate is arranged in the draft chest to direct the water into the draft tube with as little loss as possible.

Between the draft chest and the draft tube is a cast-iron base iron, which is

retically balanced. Should, however, any unbalanced thrust develop, it will be taken care of by the automatic balancing device arranged with each runner.

The tail end of each turbine is fitted with a mechanical brake, by means of which the revolving parts may be brought to a stop in a few minutes after the gates of the turbine have been shut.

GOVERNORS

The speed of the turbines will be controlled by I. P. Morris Company's governors of the double floating-lever, oil-pressure type. Each governor is arranged for belt drive from the switchboard. A friction clutch is furnished with each governor, so that the revolving element may be stopped during the operation of the turbine, without disturbing the driving belt.

The cylinder of the vertical operating engine is fitted with suitable valves and a small hand-operated, oil-pressure pump, so that the supply from the governor may be shut off and the gates of the turbine operated by hand.

The governing apparatus for each of the turbines consists of a governor, operating engine, accumulator tank, three-

throw oil pump and the interconnecting piping. The accumulator tank is made of plate steel and is divided into pressure and vacuum compartments. The cubical capacity of the pressure compartment is three times that of the vacuum compartment.

The oil pump is of the Deane three-throw type and is driven from the turbine shaft by means of a belt. The interconnecting piping and fittings between the pump, governor, accumulator tank and operating engine, are made of brass and all the parts are so designed that the governor will control the gates of the turbine satisfactorily with a working pressure not to exceed 150 pounds per square inch. Connections will be made between the governing systems of the four units, so that any pump may supply oil to any accumulator tank.

Each governor is capable of opening or closing the gates of the turbine within two seconds of time and is also capable of being readily adjusted so that the gates may be opened or closed in any given time, up to eight seconds.

In order that the four governors may be operated in parallel, they have an adjustment by which the percentage of inherent drop in speed from no load to full load may be varied from zero per cent. to three per cent. The governors are sensitive to within one-half of one per cent., and for a change in speed of one-half of one per cent. they will immediately move the gates. On sudden changes in the load, each governor will immediately move the gates of the turbine to the proper position, without excessive hunting.

The weight times the square of the radius of gyration, or the flywheel effect of the generators, is 3,100,000; the length of the penstocks is 150 feet, and the maximum velocity in the penstocks corresponding to full load on the turbines, is 8.7 feet per second. Thus it is seen that the plant conditions are favorable for good regulation.

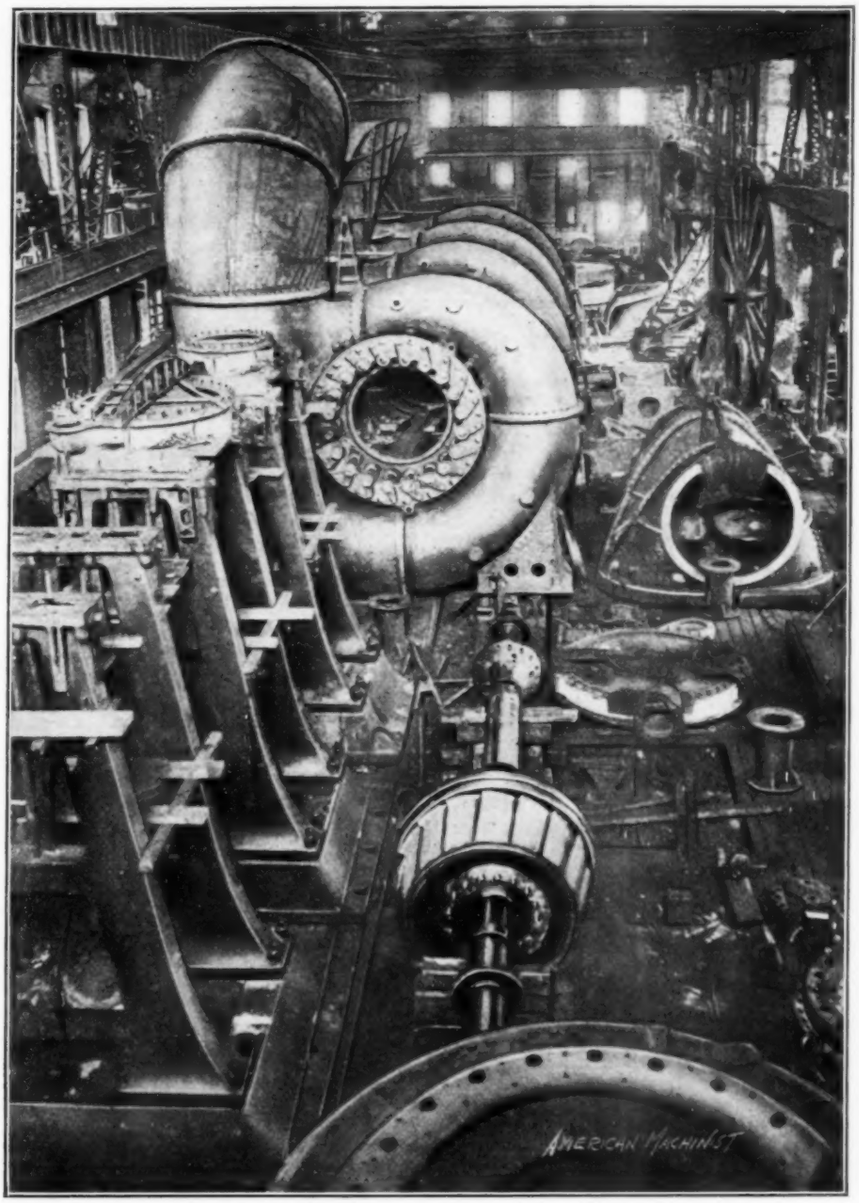


FIG. 3. LITTLE FALLS TURBINE BEING ERECTED IN THE SHOP

The facility with which the various parts of turbines are handled in erection or in dismantling for repairs, is a very important consideration in units of this size.

In the case of the Washington turbines, particular attention has been paid to the design of the various parts so that each may be removed without disturbing the parts adjacent to it, any more than is absolutely necessary.

Referring to Fig. 2, the reader will note that the bearings may be readily removed from the shaft without requiring the position of the shaft to be altered. Thus, if it is desired to remove one of the bearings, the bolts connecting the cap to the pedestal are removed and the bolts which connect the pedestal to the sole plate are withdrawn. The sub-base is then slipped out and the pedestal dropped down and removed from beneath the shaft.

Before removing the sub-base of the bearing, it will be necessary to take the weight of the shaft off the bearing, by supporting it at some other place. The means for doing this depends entirely upon the part of the apparatus which is to be dismantled. If it should be desired to take both pedestals from underneath the shaft and dismantle both head plates, the weight of shaft may be taken care of by entering the draft chest and inserting wedges in the clearances between the runner and the draft chest. If it should be desired to remove the tail bearing only, the weight of that end of the shaft may be carried by inserting the wedges in the runner clearances, but if it should be desired to remove the inboard bearing only, the inboard end of the shaft may be carried by the coupling.

If it should be desired to replace a guide vane, it would then be necessary to remove the head plate. The head plate may be removed with everything intact, except the cover plate, which contains the stuffing box of the main shaft. The cover plate is made in two sections, the division occurring on the horizontal plane which passes through the axis of the shaft. The sections are held together by bolts in the flanges on this plane.

The reach rods connecting the operating shaft to the operating ring are first disconnected and the bearing is then dismantled. The nuts on the studs connecting the head plate to the casing are removed, and the nuts connecting the cover plate to the head plate are removed.

The cover plate may then be slipped back out of the way, or by removing the bolts on the horizontal flange, it may be removed from the shaft. The weight of the head plate is then carried by the crane. To make the head plate hang perfectly plumb, a porter bar is fastened

to its lower side and enough weights are attached to the end of the porter bar to cause the head plate to hang in a true vertical position.

The head plate may then be backed out of the machined fit in the casing by means of jack screws, and with the crane it may be carried back the distance necessary to allow the removal and replacement of the guide vane. This method of dismantling applies to either end.

The turbines are so designed that the shaft and runners may be removed without disturbing the alinement of the lower sections of the casings, or the intake Y-pipe, or the upper sections of the two casings which support the Y-pipe. In taking out the shaft and runners, the supporting of the shaft, the removal of the bearings and the removal of the head and cover plates is accomplished in the same manner as already described. The brake and the connections to the governor and oil pump are then removed.

The reader will note that the draft chest is made up of seven sections and that three of these sections form a wedge in the center. By this arrangement, the upper sections of the wedge may be readily removed. When this has been done, the remaining upper sections of the draft chest may be unbolted from the wheel casings and from the lower sections of the draft chest. They may then be backed out toward the center and lifted out of place. The next move would be to dismantle the upper sections of the casings, which are connected to the sections supporting the Y-pipe.

The reader will note that the vertical joint between the two upper sections of the casings is made off center. Thus, when the upper sections of the casings which do not support the Y-pipe are removed, the shaft and runners may be readily lifted out.

Illustration Fig. 3 shows two of the units in course of erection in the shops of the I. P. Morris Company, and in the foreground is seen one of the shafts. One of the runners has been forced on the shaft and bolted to the forged hub. The enormous size of these units may be readily appreciated by the reader by referring to this illustration.

Each turbine is guaranteed to have an efficiency of at least 80 per cent. at full load, 82 per cent. at seven-eighths load, and 82 per cent. at three-quarters load; full load being 9000 horsepower, when operating under a head of 66 feet and running at a speed of 150 revolutions per minute.

New Customs Duties for American Machinery *By A. J. Wolfe*

The tariff situation with regard to American machinery abroad deserves the close attention of every manufacturer of machinery. At the present time a re-adjustment of tariff duties with regard to American machinery either has taken place or is about to take place as a consequence of the operation of the American tariff. Notably have certain changes occurred in Germany, inasmuch as that country has granted to American goods the full enjoyment of the conventional rates on all schedules.

As is well known, for some years past a commercial agreement existed between the United States and Germany, by virtue of which against certain concessions granted by this country, some American goods entered Germany with the enjoyment of certain conventional rates. The major portion of machines and machinery parts sent to Germany, however, had to pay the higher general rates of duty. At the time of passing the new tariff act the commercial agreement between the two countries was revoked, with a six months notice as provided therein, but now the flat conventional rate will prevail, and German goods in turn will enter into United States under the ordinary rates of the new tariff, Germany having been named among the countries not unduly discriminating against American products.

With regard to American goods entering Germany, there are three classes: (A) Goods which formerly passed under the higher general rate and now will pass under the lower conventional rates. Of these there are quite a number of machines and machinery accessories. (B) Goods which already enjoyed the conventional rate by virtue of the revoked commercial agreement. (C) Goods passing under tariff numbers for which there are no special conventional rates in the German tariff.

The schedule immediately following shows clearly where changes in customs duties affecting American machinery have occurred and is of special interest to machinery builders.

	General Tariff. Marks.	Conventional Tariff Marks.
A.—Machinery.	per 220 lbs.	
892 Steam locomotives, running on rails:		
Tender locomotives, the engine weighing net 10,000 kilos or less	11.00	
Tender locomotives, the engine weighing net more than 10,000 kilos; locomotives without tenders	9.00	
Tenders for locomotives	5.00	
(*No change from present status.*)		
893 Steam locomotives, not running on rails, including steam road rollers; steam locomobiles ("fahrbar"), portable or not:		
Each machine weighing net 6,000 kilos or less	9.00	
More than 6,000 kilos	8.00	
(*No change from present status.*)		
894 Steam engines, steam turbines, water-power machinery (turbines, water wheels, water-pressure engines), combustion or explosion motors, hot-air and compressed-air motors, and other motive machinery not specially distinguished (except electric motors), combined or not with dynamos, pumps, hammers, blowing machines, freezing machinery, mining engines; also fixed, portable or floating dredges, pile-driving machines and cranes:		
Each machine weighing net:		
40 kilos or less	100.00	
More than 40 kilos up to 100 kilos	60.00	
More than 100 kilos up to 200 kilos	38.00	
More than 200 kilos up to 500 kilos	25.00	
More than 500 kilos up to 1,000 kilos	18.00	
More than 1,000 kilos up to 2,500 kilos	13.00	
More than 2,500 kilos and up to 5,000 kilos	10.00	
More than 5,000 kilos and up to 50,000 kilos	7.00	
More than 50,000 kilos and up to 100,000 kilos	5.50	
More than 100,000 kilos	3.50	
Combustion and explosion motors for motor bicycles, each weighing net 40 kilos or less		75.00

	General Tariff. Marks.	Conventional Tariff. Marks.
A.—Machinery.	Per 220 Lb.	
Steam engines, steam turbines, water turbines, combustion and explosion motors, power (other than electro motive) machinery in combination with pumps (including exhausting machines), or freezing machines; cranes:		
Each machine weighing net:		
More than 500 kilos up to 1,000 kilos		11.00
More than 1,000 kilos up to 2,500 kilos		7.50
More than 2,500 kilos up to 5,000 kilos		6.00
More than 5,000 kilos up to 50,000 kilos		5.00
More than 50,000 kilos up to 100 000 kilos		4.50
Water pressure engines:		
Each machine weighing net:		
More than 1,000 kilos and up to 2,500 kilos		8.00
More than 2,500 kilos and up to 5,000 kilos		6.50
More than 5,000 kilos and up to 50,000 kilos		5.50
More than 50,000 kilos and up to 100,000 kilos		5.00
Steam engines in combination with hammers, blowing machines (including ventilating machines) or mining machines:		
Each machine weighing net:		
More than 5,000 kilos and up to 50,000 kilos		5.00
More than 50,000 kilos and up to 100,000 kilos		4.50
Other engines coming under this number:		
Each machine weighing net:		
More than 1,000 kilos and up to 2,500 kilos		10.00
More than 2,500 kilos and up to 5,000 kilos		8.00
More than 5,000 kilos and up to 50,000 kilos		6.00
More than 50,000 kilos and up to 100,000 kilos		5.00
Note.—Steam engines for use in shipbuild-		

	General Tariff. Marks.	Conventional Tariff. Marks.
A.—Machinery.	Per 220 Lb.	
ing, together with the paddle wheels and screw propellers pertaining thereto, are admitted duty free. (*Treaty with Switzerland.*) (*American goods enjoyed the conventional rate by virtue of the commercial agreement which expired by revocation. American goods will pass from now on under the lower conventional rates of 894.*)		
895 Sewing machines (including crank embroidering machines), and knitting machines to be worked by hand, without stands; top parts of sewing machines (including those of crank embroidering machines), and of knitting machines; also parts thereof (except needles)	35.00	
Knitting machines to be worked by hand, without stands, top parts of knitting machines, also parts thereof, except needles		12.00
(*American goods under this section are entitled to to the lower conventional rate hitherto unenjoyed.*)		
896 Sewing machines (including crank embroidering machines) and knitting machines, firmly attached to stands or to be driven by motors	20.00	
Knitting machines firmly fixed to stands, or intended to be worked by motive power		8.00
(*Same remark as 895.*)		
897 Stands for sewing machines (including those for crank embroidering machines), and knitting machines, and parts of such stands (including the table tops or tables belonging thereto)	5.00	
(*No change.*)		
898 Machines and parts of machines firmly attached to card clothing	20.00	
Each machine or part weighing net 200 kilos or over		18.00
(*Conventional rate is new for American goods.*)		
899 Other machines for the preparatory processes in textile manufacture; machines for spinning and twisting, including machines for winding, reeling and spooling the spun thread; also machines for the preparation of the spun thread for weaving	6.00	4.00
Note.—Warp-dressing machines, together with the rollers (of copper or copper alloy) pertaining thereto, come under this category. (*Treaty with Switzerland.*)		
Note.—Carding machines not firmly attached to card clothing come under No. 899. (*Treaty with Belgium.*)		
(*The lower conventional rates prevail now.*)		
900 Looms	5.00	4.00
Note.—Warp staff and Jacquard arrangements for looms, if imported separately, will be treated as looms. (*Treaty with Switzerland.*)		
(*The lower conventional rates prevail now.*)		
901 Curtain lace, and tulle making machines; knitting frames; embroidering machines (except hand machines)	10.00	
Embroidering machine (except hand machines)		8.00
(*The lower conventional rates prevail now.*)		
902 Dressing (finishing) machines (machines for the improvement of yarns and tissues), so far as they are not included under No. 874; machines for washing and chemical cleaning	6.00	
Machines for dressing yarns and tissues of wool and other animal hair, except that mentioned under No. 874		4.50
(*The lower conventional rates prevail now.*)		
903 Fire engines of all kinds; pumps to be worked by men or animals	7.00	
(*No change.*)		
904 Machines for working metals, wood or stone; steam and hydraulic forging presses; riveting machines and mechanical hammers (drop, pneumatic and spring hammers, and other hammers driven by transmitted power):		
Each machine weighing net:		
250 kilos or less	20.00	12.00
More than 250 and up to 1,000 kilos	12.00	8.00
More than 1,000 and up to 3,000 kilos	8.00	6.00
More than 3,000 and up to 10,000 kilos	6.00	5.00
More than 10,000 kilos	4.00	
(*The lower conventional rates prevail now.*)		
905 Ploughs to be driven by mechanical motive power with or without their motive machinery; reaping machinery	4.00	
(*No change.*)		
906 Other machinery not specially mentioned;		
Each machine weighing net:		
40 kilos or less	15.00	
More than 40 kilos and up to 100 kilos	12.00	
More than 100 kilos and up to 200 kilos	10.00	
More than 200 kilos and up to 400 kilos	9.00	
More than 400 kilos and up to 1,000 kilos	7.00	
More than 1,000 kilos and up to 5,000 kilos	5.50	
More than 5,000 kilos and up to 10,000 kilos	4.50	
More than 10,000 kilos	3.00	
Blowing machines (including ventilating machines), machines for sorting, scouring or crushing coal and ores, machines for molding coal briquets, mortar crushing machines, lifting machines (including mining machines), freezing machines, machines for polishing plate glass, machines for manufacturing and working beaver hat shapes:		
Each machine weighing net:		
More than 100 kilos and up to 200 kilos		7.00
More than 200 kilos and up to 400 kilos		6.00
More than 400 kilos and up to 1,000 kilos		5.50
More than 1,000 kilos and up to 5,000 kilos		5.00
Millers' machinery:		
Each machine weighing net:		
More than 400 kilos and up to 4,000 kilos		5.00
More than 4,000 kilos and up to 10,000 kilos		4.00
Pumps, including exhausting machines:		
Each machine weighing net:		
More than 100 kilos and up to 200 kilos		7.00
More than 200 kilos and up to 400 kilos		6.00
More than 400 kilos and up to 4,000 kilos		5.00
More than 4,000 kilos and up to 10,000 kilos		4.00
Bakers' and pastry-ware makers' machinery, machinery for testing materials:		
Each machine weighing net:		
More than 1,000 kilos and up to 5,000 kilos		5.00
Machines for taking the cream off the milk of any system (centrifugal) for milk, separators, radiators and the like):		
Each machine weighing net:		
100 kilos or less		10.00
More than 100 and up to 200 kilos		9.00
More than 200 and up to 400 kilos		8.00
(*The lower conventional rates prevail now.*)		
Note to Nos. 892-906.—According to Convention, it is immaterial whether the parts of a single article are imported at the same time or at intervals of time, or in separate consignments, or loaded on one or on several wagons. The absence of accessory parts, or even of certain principal parts (fly-wheels, axles, pillows, bed-plates, or the like), is also of no consequence. If the duty varies according to the weight of the article, duty will be levied on the total weight thereof actually imported, without regard to missing parts.		
B.—Electro-technical Apparatus.		
B.—Electrical-technical Apparatus.		
907 Dynamos, electric motors, continuous-current transformers, as well as finished armatures and collectors; converters and reaction coils:		
Each machine weighing net: 500 kilos or less	9.00	
More than 500 and up to 3,000 kilos	7.00	6.00
More than 3,000 kilos	6.00	
More than 3,000 and up to 10,000 kilos		5.00
More than 10,000 kilos		4.00
Notes.—1. Machines firmly attached to dynamo generators or motors are subject to duty according to Section A.		
2. When the articles specified in No. 907 are imported in an unfitted condition, it is agreed conventionally that the rules relating to the Customs treatment of unfitted machines shall apply.		
(*The lower conventional rates will prevail now.*)		
908 Accumulators and their electrodes:		
Not combined with celluloid, similar molding materials or vulcanite	6.00	
Combined with celluloid, similar molding materials, or vulcanite	24.00	
(*No change.*)		
909 Electric cables incased in a protective cover of metal, in the form of sheet, wire or the like, for conducting electric currents, and intended to be laid under water or in the earth	8.00	
(*No change.*)		
910 Arc lamps and cases for the same:		
Arc lamps	40.00	
Complete cases for arc lamps in combination with glass globes covered with network or not; reflectors; searchlights	20.00	
(*No change.*)		
911 Electric incandescent lamps	80.00	
(*No change.*)		
912 Telegraph appliances, electrical; telephones; electric appliances for illumination, transmission of power, or electrolysis, and for surgical and dental purposes; electric measuring, counting and registering apparatus; resistances and shunts; galvanic and dry batteries and thermo-electric couples; other electrical appliances; component parts of such articles	60.00	
Electric appliances for illumination, transmission of power or electrolysis; electric measuring, counting and registering apparatus; resistances and shunts; other electrical appliances not specially mentioned, and component parts of such articles:		
Each article weighing net: 10 kilos or less		40.00
More than 10 kilos and up to 25 kilos		30.00
More than 25 kilos and up to 100 kilos		20.00
More than 100 kilos and up to 500 kilos		8.00
More than 500 kilos and up to 1,000 kilos		6.00
More shan 1,000 kilos		4.00
Notes.—1. Insulating coils, bells, and buttons, bobbins, keys, switches and similar parts of electrical fittings of earthenware, porcelain or glass, not combined with other materials, and not admitted as parts of electro-technical appliances imported in sections;		
White		10.00
Colored		20.00
2. Insulating appliances (bobbins, safety boxes, tubes, disks, rings and the like), of asbestos, asbestos paste, mica or micanite, for electro-technical purposes		15.00
Note to Section B.—The nature and condition of the material used for electro-technical products has no effect upon the tariff classification for duty.		
(*The lower conventional rates will prevail now.*)		
913 Drills not otherwise mentioned, tongs or pincers; cutters for vines and roses; hedge shears; pruning shears; sheet-metal shears; sheep shears; chisels; planes; tube cutters; ratchet drills; packing fillers; machine knives; taps; cutting compasses	20.00	
Drills not otherwise mentioned, taps		15.00
Machine knives		18.00
(*The lower conventional rates will now prevail.*)		

Some Rotary Milling Operations

*By A. J. Baker**

The operative efficiency of a milling machine is to a very large extent dependent on the tools and fixtures provided. A machine of high mechanical efficiency, fitted with labor-saving devices in the way of speed- and feed-change levers, starting clutch, etc., on which the cutting time does not exceed 30 per cent. of the total time, is surely not in conformity with modern ideas.

The equipment of the machine should be designed with a view to keeping the cutter in constant action at the maximum feed and speed which the job will stand. The following examples of continuous milling are taken from the shops of the Cincinnati Milling Machine Company, Cincinnati, Ohio. The fixtures, Figs. 1 to 4, were designed for manufacturers using the machines on which the jobs are shown.

Type of Fixture

The fixtures for the two operations illustrated are of the rotary type, a type which comes near to the ideal for milling operations. When it can be applied, the work can proceed at a rate just sufficient to allow the workman time enough to insert and remove the pieces. There is no return of table, no gap in the cutting, no starting and stopping of the machine, no wait while the fixture is loaded. The movements of the operator are reduced to two, and with so simple a cycle, a much higher speed can be attained than with work of a more complex nature.

Both of the jobs illustrated are handled on a No. 2 Cincinnati Vertical Milling Machine, fitted with 20-inch circular milling attachment. In Fig. 1 the operation of milling the surface of sad irons is shown.

How the Sad Iron Is Held

For this a special fixture, shown in detail in Fig. 2 is used. It consists of a main body, the general shape of which is conical, provided with seven lugs on which the work is held. The center of the fixture carries seven pins, with knife-edge heads, the lower angle of the knife-edge being more obtuse than the upper, and so tending to force the work down on the bottom of the fixture.

To each of the lugs is fastened a hardened tool-steel gripping block, also furnished with a knife-edge; the other side of the block is rounded to form a bearing, on which the holding wedge may oscillate and adjust itself to the irregularities of the casting. This holding wedge may move freely toward the center of the fixture and as it moves in, also moves sidewise owing to its wedge formation, and so holds the work, by expanding against the inside of the vertical wall of the sad iron. The head of the wedge is turned over, forming a projection between which and the rear of the gripping block the ejector rod may be placed.

Ejector Rod and Wedges

This rod, which also carries a lump of babbitt cast around its outer end, is used both for gripping and releasing. The three supporting points on which the work rests are the two screws on each side of the lugs, and the central plate to which are attached the knife-edge pins. These supports are at the outermost points of the work, and render it thoroughly stable.

The wedges are prevented from lifting and coming out of the slots, by two shouldered screws, which have 1/16 inch clearance between the sides of the slots, but are a reasonably tight fit under the heads. This permits the requisite movement in a horizontal plane. The wedges are prevented from sliding out of the slots by the large fillister-head screws shown in Fig. 1, in the periphery of the fixture.

The Operation and the Cutter

In operation the work is placed on the upper points, and against two of the knife-edge pins; the wedge is then hammered home with the babbitt ring. After it has passed under the cutter, the work is released by the heel of the ejector rod being placed between the wedge and the gripping block. A slight jerk releases the wedge, and permits the work to be removed.

The cutter shown in Fig. 1 is of the

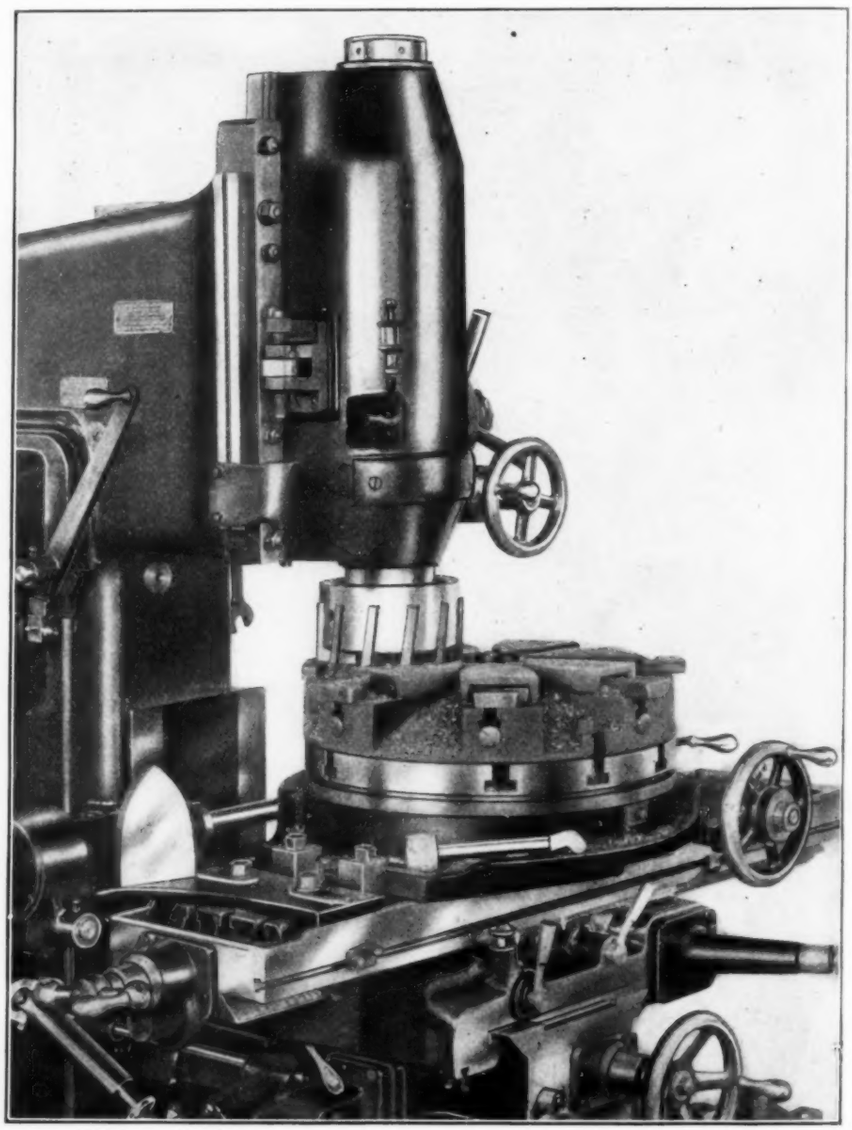


Fig. 1. Rotary Fixture for Milling Sad Irons

*In charge jig- and tool-designing department, Cincinnati Milling Machine Company.

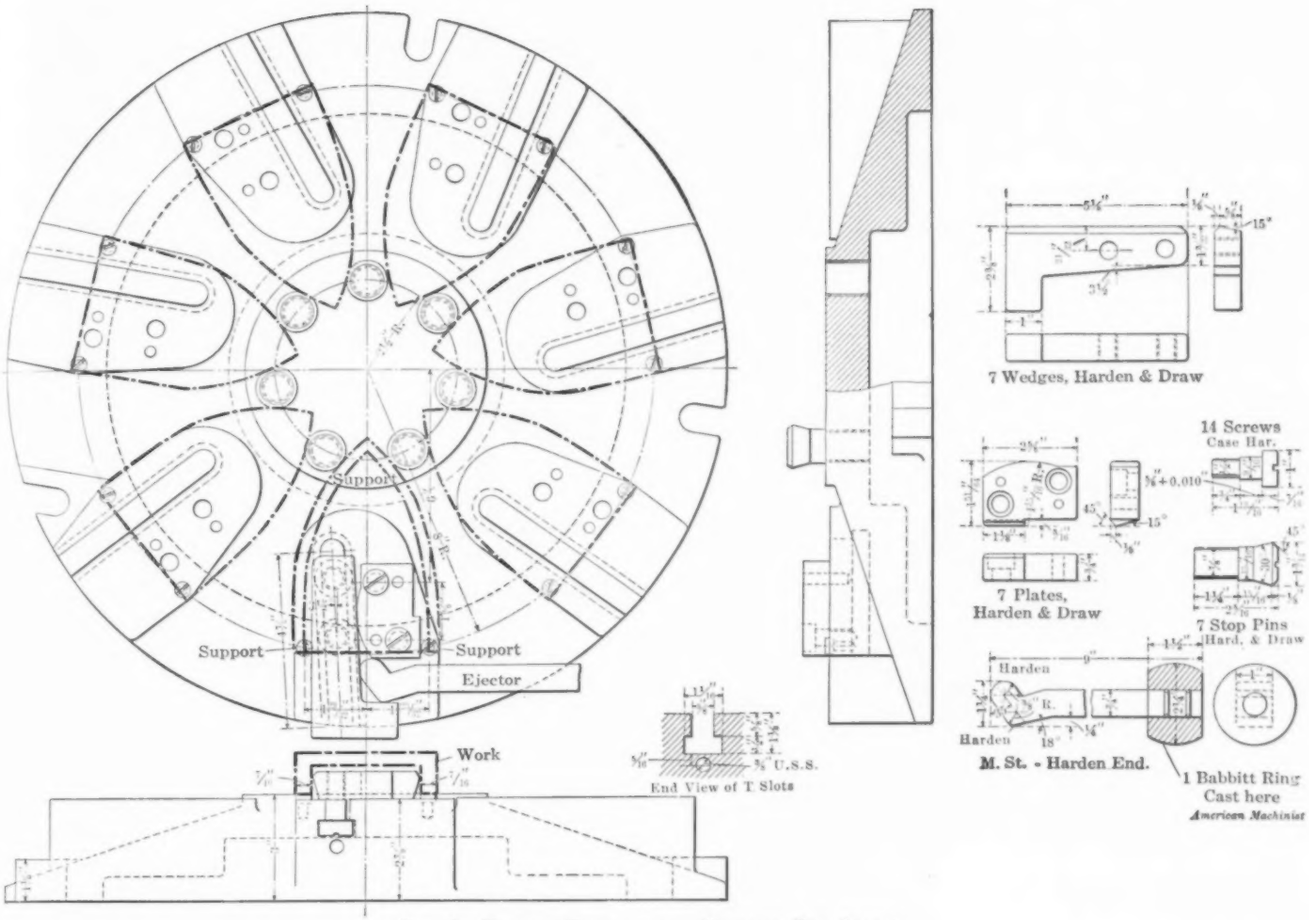


FIG. 2. ROTARY FIXTURE FOR MILLING SAD IRONS

high-power type, but a 7½-inch standard mill with its greater number of teeth, gave the best results. The output, of course, varies according to the finish desired, and the amount of polishing which the piece afterward receives. In trying out the fixture we used a 20-inch per minute feed, giving a table rotation in two minutes, which means that a sad iron was finished in 18 seconds. The speed of the cutter was 19 revolutions per minute and about 1/16 inch of metal was removed.

MILLING A CIRCULAR BEARING

The second example is the milling of the circular bearing of a bracket carrying a gear, and fitting on a round member 3⅞ inches in diameter. While this is a case where the cutting takes place on the side of the mill as opposed to the more favorable cutting which results from using the face, it is nevertheless a good example of continuous milling. It is shown in Fig. 4.

The fixture shown by Fig. 3 is designed to carry three pieces. They are located by means of the 1-inch hole, which has been previously bored. The piece is backed up by three movable screws *A* and one set screw *B*, and end strain is taken care of by the two adjustable stops *C*. The setting piece shown at *D*, together with a 3⅞ plug, are used to get the

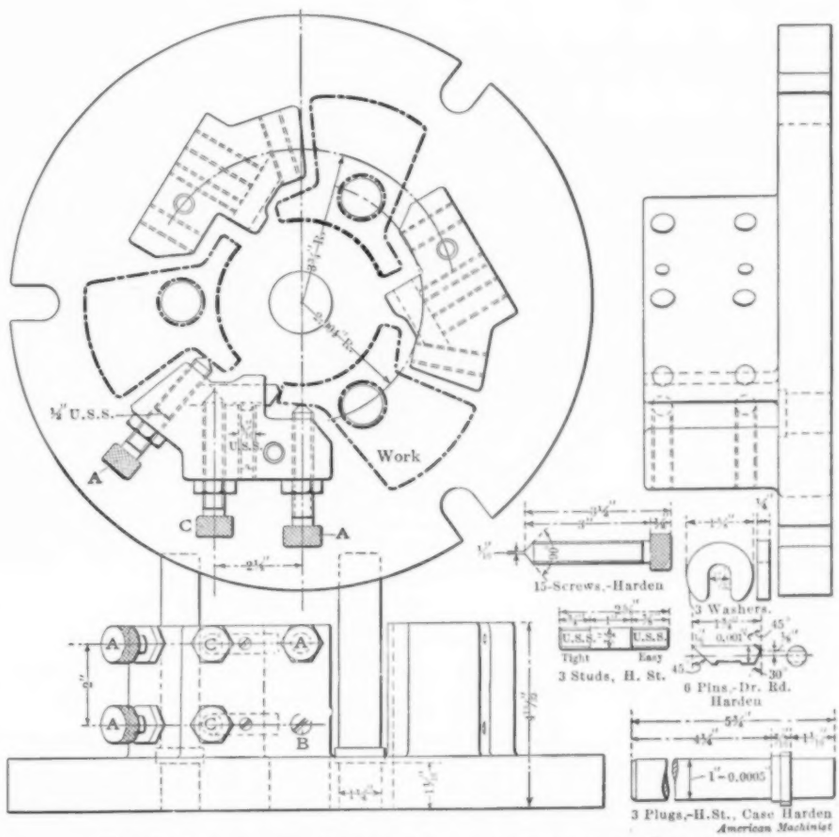


FIG. 3. FIXTURE FOR MILLING CIRCULAR BEARING IN BRACKET

right diameter. The speeds and feeds used on the job were 100 revolutions per minute of a 1½-inch end mill, 20-inch table feed per minute, giving 40 seconds per piece as the time for the complete operation. The length of cut was about three inches and ⅛ inch of metal was removed. The milled surface was parallel with the bored hole within 0.0015 inch.

It may be said, that while the original cost of such fixtures as those described above is greater than a simple single fixture would be, yet the increased output of the machine will more than repay for the additional original investment.

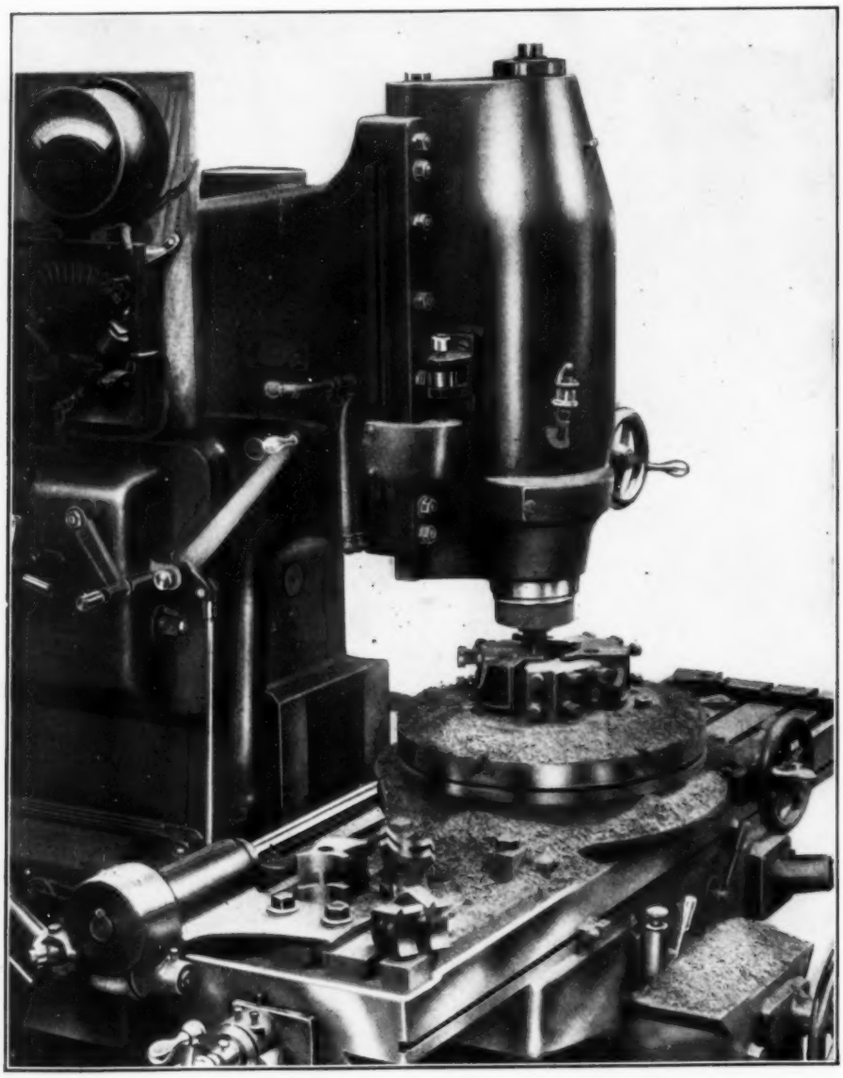


FIG. 4. MILLING A CIRCULAR BEARING IN A BRACKET

Those interested in the development of aërial navigation will be glad to learn that the Aëro Club of America has secured quarters in the Engineering Societies building, 29 West 39th street, New York City, which now forms the home of twenty-five engineering bodies with some 30,000 members.

On Intelligent Employers

BY ENTROPY

There are a number of men in this world who have reputations for having made money and for being philanthropists. This particular one is rated as having more millions than any man needs and also as having spent quite a number of substantial slices in the aid of working people. He made this statement the other evening. "In my factory we could hire helpers for $1.50 per day. We do not pay anyone less than $2. Where we could hire for $4 we pay $5. That is the way I made my money."

Last fall when we built the new north shop we let it to the lowest bidder at what seemed to us a ridiculously low price. What was our astonishment to find that he was paying from 75 cents to $1 per day more for brick masons than the union rate. The brick work went up famously and it is as good a piece of work as can be seen in a hundred miles. On the other hand he paid his carpenters only the flat union rate, and the carpenter work was only fairly well done and he made a slow job of it. What is the answer?

As I figure it out the cases are alike. Mr. Crœsus worked in a factory when he was young. He found out, what everyone knows, that a man can earn a lot of money if he sees fit to, but if his rate is cut he becomes dispirited. The second man was an expert bricklayer himself. He knew how to conduct his work to get the best results and he realized the same thing. He did not know the carpenter's trade, so all carpenters looked alike to him.

You may ask and likely will, "Does not paying extra high wages make a man feel that he is above work, and above his fellows, in other words produce a swelled head?" To which I say as Mr. Crœsus did, that indiscriminate raising of pay through the whole shop would have that effect, but the singling out of capable men and paying them what they can really earn as compared with the general run of help does not have anything but a good effect. There are and always have been a few men who have either a natural or an acquired gift for getting out work. Usually they are paid a quarter a day more than the rest of the men. They work easily, hold their jobs without effort and are always sure of a job.

Occasionally a good business man, like our friend Mr. Crœsus or the contractor, singles those men out who can do 50 per cent. more than a "good day's work" and gives them the 50 per cent. in wages, pocketing the saving in overhead charges due to the increased work done and the fact that these men need next to no supervision. The saving right there on a hundred men would make a man rich. The result is, these men have the best job they ever had, they do not want to lose it, they know that their work is being watched and they know that they are paid for results. As a result, Mr. Crœsus said, he owns them body and soul.

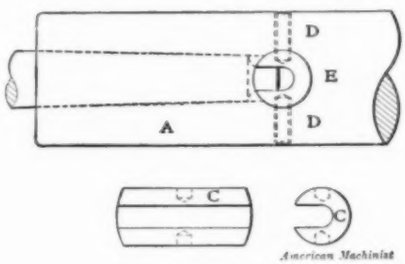
For that very reason, and I believe his statement is literally true, it is fortunate that many of our employers are not men who can see the advantage of such methods of dealing with help. Fact is there is not a very large proportion of the employers whom I have met to whom I would want to rent out my body, to say nothing of my soul. Those who have the breadth of mind to see the virtue of this method and the strength of character to go ahead and do it, permanently, are men who are pretty safe to work for.

In fact I feel that next to picking the right man to borrow money of the next most delicate and dangerous man to select is the man to work for. Most men find it so difficult that they give it up and just work for themselves which may account for the complaint as to the difficulty of obtaining intelligent service.

Letters *from* Practical Men
Concerning *the* Details *of* Making things *in* Machine shops, *from the* First Sketch *to the* Sale

A Repair for Worn Tang Slots in Drill Press Spindles

The line cut shows a simple and efficient repair for drill-press spindles which have worn-out tang slots.



A SPINDLE REPAIR

A is the spindle. The slot is drilled and reamed out as shown by the circle at *E*. A tool-steel plug is then made, as shown at *C*, to fit the hole *E*, and with a slot milled in one side of it to fit the drill tangs. The plug is then tempered and fastened in place by the grub screws *D*.

J. R. BURKHARDT.

Springfield, Ohio.

About Etching Tools

Certain difficulties often occur in marking tools with acid; probably the most common being the very slow action of an acid (or mixture of acids) on one tool, that had been satisfactorily active on other tools.

The slow action is often on case-hardened tools. No one thinks the physical hardness of the metal retards acid action. Is it because of changed chemical composition?

We hear of nitric acid attacking iron and steel more readily when not too strong, but have never seen a demonstration.

A knowledge of the reason for failure of an acid in one case that had worked well in other cases would not only be interesting, but would help about overcoming other similar difficulties.

I remember failing to satisfactorily mark some cast-iron straight-edges with a mixture that had worked well on steel. The acid would attack the cast iron readily, but soon cease working, leaving the surface acted on thickly incrusted with a black substance. Was this the graphitic carbon that the acid would not "take up?"

Is it true that the mixture of nitric acid and muriatic acid usually used (about 3 parts nitric and 2 parts muriatic) is better for standing a day or two after mixing; and that it should always be kept tight stopped to preserve its strength?

If anyone can and will give me answers to part or all of the questions I shall be obliged.

Morton Park, Ill. WM. S. ROWELL.

Socket Chucking Device for Short Drills

Not long ago I noticed in a shop devoted to the working of sheet metal, a scheme for driving drills which is well illustrated by the accompanying halftone. The table shows detail dimensions.

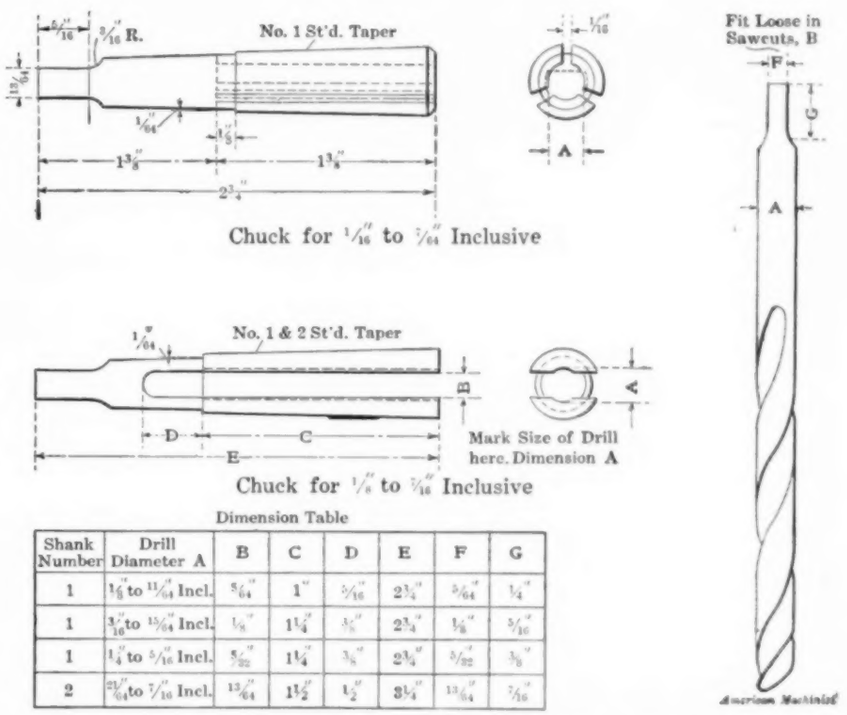
In this shop many holes are drilled with electrically driven drills through plates from 1/32 to ¼ inch thick and varying in diameter from 1/16 to ⅜ inch. Many of the holes are in inaccessible places and in breaking through the sheets many drills are broken; the record, so far as I was able to learn, being 50 drills in one day for one man. It is not unusual for a man to break 10 drills per day.

Formerly taper-shank drills were used exclusively and to cut cost of breakage, chucks were provided to take the short drills. This worked all right except in corners or other close places where the chuck body interfered, and to meet the problem of using short-set drills in close

FIG. 1. SOCKET-CHUCKING DEVICE

quarters the scheme here shown was worked out. The taper-shank drills have also been abolished.

Milton, Penn. F. A. HINK.



Dimension Table

Shank Number	Drill Diameter A	B	C	D	E	F	G
1	1/16" to 11/64" Incl.	5/64"	1"	5/16"	2 3/4"	5/64"	1/4"
1	3/16" to 15/64" Incl.	1/8"	1 1/4"	3/8"	2 3/4"	1/8"	5/16"
1	1/4" to 5/16" Incl.	5/32"	1 1/4"	3/8"	2 3/4"	5/32"	3/8"
2	21/64" to 7/16" Incl.	13/64"	1 1/2"	1/2"	3 1/4"	13/64"	7/16"

FIG. 2. DIMENSIONS OF SOCKET-CHUCKING DEVICE FOR SHORT DRILLS

Discussion *of the* Previous Question

Letters from Our Readers Showing how many Men of many Minds Look upon Various Subjects Opened up in previous Numbers

Hardening Ring Gears

On page 126, of the AMERICAN MACHINIST, I note the experience of John Gard in the heat treatment of some gears. In the first method they were submitted to 1560 degrees Fahrenheit for 7 hours. This is entirely too long as the carbon should enter the 0.20 carbon steel at the rate of 1/16 inch per hour after the heat had reached 1560 degrees. Then the reheating for quenching should not have been more than 1300 degrees instead of the 1500 used. The next lot was heated to 1560 degrees and quenched in oil, reheated for the second quenching at 1430 degrees. While this is better than the first treatment, he used 130 degrees more heat in this treatment than necessary. In the third method, where the expert's advice was followed, he used a drastic cooling bath and still heating to 1430 degrees for quenching. The fourth method which should have given him the key for doing his work is the only sane heat he had given any of his work. If it only required 1300 degrees heat when using the lead bath to heat for quenching in oil, why would it be necessary to heat to 1430 degrees when quenching in brine?

The proper way to do this class of work is to use sufficient heat to drive the carbon into the steel in the shortest possible time conducive with safety. To submit steel to a heat of 1500 degrees for 7 hours, means to greatly injure its physical qualities, therefore when carbonizing gears, they should be packed in a round box or tube, and surrounded by at least ½ inch of bone dust, and the heat should strike on all sides equally. While they will carbonize at 1560 degrees Fahrenheit, it is better to run the heat a little above this and do the work in a shorter time. There should not be any fire clay used to prevent carbonization, on a gear of this size, for there will be sufficient strength left in the piece after hardening if the piece is not carbonized more than 1/64 inch deep, which he states is the desired depth.

It is not necessary to allow these pieces to cool below 884 degrees Fahrenheit (red visible in twilight), before the heat for quenching can be started. After the piece has once cooled to this heat, it is not necessary to allow it to become entirely cooled before reheating for quenching. They can be taken from the box and placed in lead to heat, or returned to the furnace, which is the better method in this case. The heat for the quenching should be as low as the piece will harden at, therefore, if it will harden at 1300 degrees Fahrenheit when heated in a lead bath and quenched in oil, it will harden at a lower heat if quenched in brine. The brine may produce a better grain than the oil, but it will not produce a better gear as long as it is not drawn to more than 450 degrees after quenching. The grain in the carbonized part counts for nothing compared with the grain in the body of the gear, as it is hardness that is wanted there.

In reference to the low heat used in the forging, causing the distortion, I would say these pieces are, or should be annealed, previous to being machined or even case-hardened. The first thing to do to a piece of steel that is to be carbonized, if we wish to prevent distortion, is to anneal it, no matter how low it is in carbon. Mr. Gard states that the fracture was much like that of wrought iron and showed fibers that closely followed the shape of the forging. No better condition could be wished for in a forging than this, and anything to the contrary would not be correct, therefore we could not attribute this trouble to the heat used in the forging.

If I were to describe an exact method for carbonizing these gears, the first important thing would be to anneal the pieces thoroughly, as this means the liberation of any strains that may have been set up in forging or rolling the metal and these strains will cause distortions that become permanent when the piece is quenched. After the pieces were machined and cleaned of all grease or scale ready for carbonizing, I would pack them in a round tube as described above, lute the top with fire clay to make it tight and place it in the fire. If the steel would permit, I would raise the carbonizing heat to 1652 degrees Fahrenheit or more. After the box and contents had reached this heat, I would allow it to remain for 30 minutes. I would then shut off the fire and allow it to cool to 884 degrees Fahrenheit and then remove the box. If the gears harden sufficiently at 1300 degrees Fahrenheit when quenched in oil, they should harden if quenched in brine at a temperature from 125 to 175 degrees lower. However, the quenching heat should not be below the recalescent point. Do not try to produce a fine grain in a piece of carbonized work by repeated quenching, but raise the heat when carbonizing to a point where it will produce a good grain when the piece is reheated and quenched.

Where the steel is below 40-point carbon, it will be necessary to raise the carbonizing heat to 1652 degrees Fahrenheit before starting to anneal. In order that we may know when our work has reached the degrees indicated by the pyrometer, where the fire end is exposed directly to the blaze, it will be necessary to use a tell-tale placed in a hole bored in the center of the box so that it can be drawn out whenever necessary to get the temperature of the contents.

Davenport, Iowa. C. U. SCOTT.

Mistakes Made by Draftsmen

I was interested in reading the article by G. E. Flannagan, entitled "Mistakes Made by Draftsmen" on page 119, Volume 33, Part 1, to learn that frequently *"experienced draftsmen utterly fail to grasp the principles of the simplest and most ordinary mechanical devices."*

This is rather sweeping condemnation, and as a member of the despised brotherhood I felt suitably taken down and depressed, but eventually braced myself up to try to bear the public exposure of the shortcomings of myself and my fellow sinners; and if not too hardened an offender in the path of wrong, to repent of my evil ways and try to turn over a new leaf.

After reading the lucid and enlightening exposition of the principles which govern the construction of a cotter joint, I was filled with admiration for the master mind which was capable of descending to the elucidation of such an apparently minor matter. However, as I pondered, grave doubts commenced to assail me. It reminded me too forcibly of an article dealing with this particular class of joint, which I had read years ago, in an elementary treatise on machine design, when a student at an evening technical class.

Mr. Flannagan's chief cause of complaint appears to center itself upon this same cotter joint. Really, before reading his article, I had no idea that this apparently simple piece of work contained so many pitfalls for the unwary. But this only serves to illustrate how deceptive appearances are.

But speaking seriously, the examples Mr. Flannagan gives are really too absurd. These errors are such as might very occasionally be made by an exceptionally thick-headed drawing office apprentice during his first few months, but there are very few offices where they would not be detected before getting into the shop. There is no justification for quoting these as though they were com-

mon drawing-office mistakes. There are very few offices where a draftsman could hope to retain his job if he were guilty of such stupidity.

It is rather a pity, but it is a failing with some people, when they have an itching to burst forth into print and have nothing new or original to impart, to fall to decrying the drawing office. I suppose it is the safest thing to do under the circumstances. But it is not very difficult to set forth a number of more or less imaginary mistakes which might be made in connection with any particular piece of work. It is absurd, however, to include these in a sweeping condemnation, as though they were the usual thing.

The trouble which is often taken by the drawing office to make a machine "foolproof" would seem to indicate that there are others besides draftsmen, who sometimes do that which they should not do.

Coventry, England. T. B.

Co-operative Industrial Education

In the report of E. F. Du Brul as quoted on page 116 of AMERICAN MACHINIST, it is stated that, "the University of Wisconsin and the Massachusetts Institute of Technology have adopted the Schneider plan for engineering education and through the University of Wisconsin the system will no doubt spread all over that State in all grades of schools." In reply to inquiries made I am informed by Dean F. E. Turneaure, that,

"This University has not adopted the Schneider plan for engineering education. This plan was considered at some length last year with a view of coöperating with some of the Milwaukee shops at semester intervals, but after studying the situation over, and taking a census among our students of shop experience they had already had, we came to the conclusion that only a very small proportion of our students would care to avail themselves of such a plan or would be profited thereby. We found, for example, that among our senior mechanical engineers the average period of shop experience which they had had was something over two years each.

"Possibly the AMERICAN MACHINIST has confused this plan with the correspondence work we are doing in Milwaukee and elsewhere."

And by Professor Peter Schwamb I am informed that,

"So far as I know the Massachusetts Institute of Technology has not yet adopted the Schneider plan for engineering education.

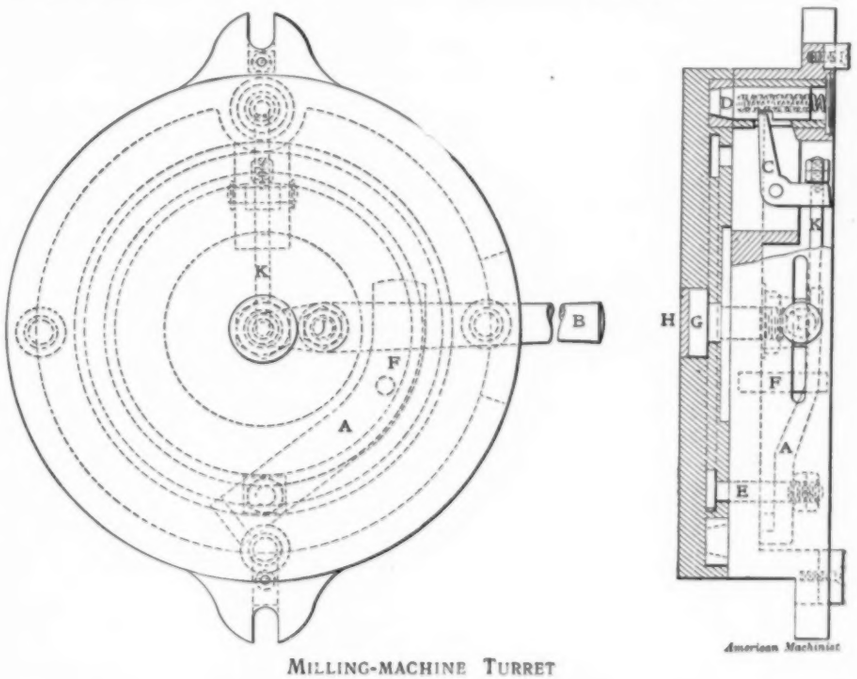
"I do not know from what source Mr. Du Brul obtained his information. Several years ago we had under discussion at the Institute a special (not a regular) course for instruction in electrical engineering, and a plan practically the same as the Schneider plan, the students spending one-half their time at the Institute and one-half the time in the shop, the periods alternating. This plan was carefully discussed but was not adopted at the time on account of the industrial conditions then obtaining.

"So far as I know the matter is not under consideration at the present time. It cannot be said therefore that we have adopted the plan."

WM. T. MAGRUDER.
Professor of Mechanical Engineering,
The Ohio State University.

A Milling Machine Turret

Apropos of the discussion and criticism at page 175 on the milling-machine turret which was presented at page 998, Volume 32, Part 2, I am sending a sketch and description of the one used in our shop. This turret is used, not so much for clamping pieces directly thereon as for holding jigs which it is necessary to turn for the various operations.



MILLING-MACHINE TURRET

The body of the fixture is cast with two lugs for taking the table-clamping bolts and two steel guides are also inserted for the table slots. On the upper face of the body is a projection which centers the table. The shoulder bolt *G* holds the table and body together. A plug *H* is placed over the bolt so as to exclude all dirt. Around the under side of the table is cut a circumferential T-slot in which is a clamping bolt *E*. The flat piece through which the bolt *E* passes has one end turned up to bear against the under side of the body, while the other end is formed on a taper. The lever *B* pivots about the stud *J* and projects through a slot in the front of the body. This handle bears against the tapered portion of *A* so that when pulled to the left it forces *A* down and tightens the clamping-bolt *E*. A pin *F* serves to maintain *A* in its proper position at all times.

Operating from the extreme end of *B* is a rod *K* which slides through the bell-crank *C*. When handle *B* is pushed to the left *K* simply slides through *C* but when *B* is pulled to the right the bell-crank *C* depresses the indexing-pin *D* which is forced into the tapered bushing in the table by a spiral spring. This spring is held in place by a nut in the bottom of the table. In this particular case there are four bushings in the table, though the number could be adapted to the class of work to be done.

It will be seen that the table is released and the indexing pin withdrawn by the one operation of the lever, leaving the one hand free to turn the table, when the indexing pin can be inserted and the table locked by a reverse operation.

For work requiring other than 90 degrees rotation the table can be indexed on the outer edge. This does not interfere with the working of the index pin, as it would simply be held against the under side of the table by the spring, the rod *K* merely sliding through the crank *C*.

The bolt *G* is not used in clamping the table, only serving to keep it down to its proper position. The clamping being done at a considerable distance from the center, is much more effective and does not wear the center bolt, thus tending to destroy the accuracy of the movement. It would not seem necessary to use a tapered boss as suggested at page 175, as there will be practically no wear about the center. However, the overhanging table would be excellent as keeping out all dirt. Suitable T-slots are cut in the top of the table.

Chicago, Ill. D. S. MANN.

Why Are Pyrometers Discontinued?

I would call attention to a very serious error in Mr. Scott's paper on the above subject, which appeared in the AMERICAN MACHINIST, on page 1077, Part 2 of Volume 32. The use of sodium carbonate, as he recommends, is in some respects very objectionable. In the first place the freezing of the liquid sodium carbonate does not take place at 1497 degrees Fahrenheit. The examination of a large number of samples, bought in the ordinary way, shows that the freezing point falls between 1544 and 1557 degrees Fahrenheit. There would probably be very little error therefore in presuming that pure sodium carbonate as bought solidifies at 1550 degrees Fahrenheit.

It should, however, be observed that fluid sodium carbonate very readily absorbs sulphur fumes from the furnace gases, and in this manner a portion of it becomes transformed into sodium sulphate, which has a very corrosive action on the iron casing of the thermo-couple, and further sodium carbonate very readily forms fluxes. If the ash from the fuel, or any sand or grit blowing about the shop happens to fall on the sodium carbonate, then it is at once fluxed with the formation of sodium silicate, and the melting point is correspondingly lowered. These considerations are not of any value so long as the calibration of the pyrometer is being carried out under laboratory conditions, but they may introduce errors into workshop practice which had better be avoided, and which can be avoided by the use of sodium chloride instead of sodium carbonate, as fully explained in my contribution entitled, "The Calibration of Industrial Pyrometers," on page 502, Part 2, Volume 32. From Mr. Scott's remarks I think he cannot have noticed this article, as full instructions are there given for accurate calibrations.

I quite agree with Mr. Scott that the hardening shop should be fitted up with as accurate instruments as in the laboratory, and this must be so if good and reliable work is to be done. I would also emphasize the importance of preventing the flames of the furnace from playing on the end of the pyrometer, which should be near to, or, if possible, in actual contact, with the work in hand.

Mr. Scott is quite right in saying there is only one accurate way of taking positive heats, and that is by the use of baths such as lead, salt, etc., but must disagree with him as to the superiority of the lead over other baths. The salt bath has been discredited just as much as the lead bath, but if the hardener will only use the correct salt, or mixtures of salts, good results are bound to accrue. Such substances as sodium carbonate, potassium nitrate, yellow prussiate, and soda must be left out, in fact their wilful addition to the salt bath seems quite impossible to justify.

The great disadvantages of the lead bath are that the specific gravity of the lead is higher than that of steel, and for this reason the articles to be heated must be forced into, and held down in the bath, and this drawback is very obvious when such things as springs are to be hardened. The lead also has a tendency to stick in cavities and between teeth. It is easily oxidized, and can dissolve its own oxide and sulphide, and through the agency of these substances cause soft spots.

One of the great advantages of the comparatively high melting point of the salt bath mixtures is that it protects complicated tools from too rapid and irregular heating. On immersing the tool in the molten salt, the salt in its immediate neighborhood is reduced below its melting point, causing a layer of salt to freeze around the tool. The salt being a poor conductor of heat, this layer remains intact until the tool has absorbed sufficient heat to raise it to the melting point of the salt. The melting point of lead on the other hand is very low, and whatever momentary sheath of lead may envelop the cold tool, affords little, or no protection.

W. H. D.

Sheffield, Eng.

Training of Trade School Teachers

On page 246 Entropy bursts into print on the "Training of Trade School Teachers" and for two pages discourses on many sides on and off the subject.

I am not a trade school teacher nor do I consider myself qualified to spread out my opinions on the training of teachers, but there are certain statements in Entropy's effusion upon which I feel that I am more qualified to write than he is. Since he has lumped teachers into a general class without discrimination and has defined a teacher as "any man without enough red blood in his veins to fight his way through the world" it behooves some of us to speak. He also states that teachers ought to be lion trainers; I don't know what sort of schools they have in his town but if that is the sort of teacher they need and the kind they get is without red blood it is easy to understand why Horace Greely said "Go west, young man, go west."

Entropy deplores that "Another tendency among teachers is the desire to be a professor." Now it is right here that I consider myself qualified to speak. First, his definition of a professor is incorrect; he might just as well say that any workman in an authorized machine shop is a foreman. A professor is not only a member of the faculty of an authorized and a *recognized* institution of learning but he is also to hold that high *rank*. Just as there are ambitious workmen who desire to become foremen and superintendents so there are ambitious teachers who desire to become professors. Most of us do not care 10 cents whether we are called professor but the desire for promotion is legitimate and human. To deplore the ambition to rise is to deplore that which is the best reward of labor.

Iowa City, Ia. F. G. HIGBEE.

Hardening High-speed Steel

On page 324 of the AMERICAN MACHINIST, under the title "Heat Treatment of Steel," by E. M. Bain, appeared an article which to say the least is very misleading.

The material that makes high-speed steel capable of holding its cutting edge when it is raised to a dark red heat, while at work, is tungsten. With this, chromium is added to give the metal a finer grain and greater hardness. In most of the best grades of high-speed steel the tungsten is 18 per cent. and the chromium about 6 per cent. The tungsten is a refractory material that raises the temperature at which the steel should be hardened to obtain its greatest degree of hardness, and consequently its best cutting quality, and this material is not added in any percentages, however slight, to the carbon steels, or to any of the special steels except high-speed steel. The temperature at which tools of high-speed steel should be heated for hardening, to get the best results as to cutting qualities, is around 2400 degrees Fahrenheit. Where the pyrometer is not used, the tools are usually heated until the metal in the point of the tool begins to melt and then it is quenched.

To submit a carbon steel to this treatment would mean that it would be burnt so badly that it could be crumbled under the hammer, and none of the materials used in the composition of carbon steel can possibly overcome this effect; in fact, 1650 degrees Fahrenheit is considered a very high temperature at which to heat carbon steels for hardening, especially if the carbon content is very high.

This means one of two things with Mr. Bain's experience: The first is that he obtained a high-speed steel by mistake for a carbon steel; and the second is that his hardener hardened the high-speed steel at the same temperature that he would a carbon tool steel, and consequently did not get anywhere near the best results for cutting properties that could be gotten out of high-speed steel.

This is a proposition in metallurgy which has been clearly demonstrated time and again, and one in connection with which there are no longer any "ifs" or "buts." One of the most difficult

things in the handling of high-speed steel is to make the hardener realize that he does not injure it by heating it to the high temperatures, but that he makes it better. In some cases it is very difficult to get him to heat the high-speed steels up to the temperature desired, owing to the fact that he has ruined so many carbon-steel tools by overheating them.

A more charitable view of Mr. Bain's statement might be based on the possibility that the shop had not been using high-speed steel but had been using some of the so-called high-speed steels that are very low in tungsten and chromium, and consequently cheaper; but even then they should be heated to a higher temperature, for hardening, than carbon steels will stand, especially the high-carbon steels that are used for tools.

New York City. E. F. LAKE.

Financial Mechanics of Aviation

Somebody is going to get hurt with those "Financial Mechanics" of M. C. Krarup's! Just for instance—on page 301 he gives some data of performance that look all right and then proceeds to draw conclusions without first procuring a warrant.

He cites an aëroplane which travels 35 miles an hour with a propeller thrust of 250 pounds and then computes the effective horsepower on a basis of the distance a body will fall in a second. Now this distance has nothing to do with the case. There is no more reason for taking the distance a body will fall in a second than in any other space of time, and for any other time the result will come out differently.

If, for example, he will take the distance a body will fall in one-half second, which is four feet, roughly, and apply the same reasoning, he will obtain $250 \times 4 \times 2 \times 60 = 120{,}000$ foot-pounds, or half the result he gets on the one-second basis. Or, why didn't he figure the distance a body will theoretically fall in a minute; something like eleven miles? His result would then be several hundred horsepower instead of seven and it would look like better "Financial Mechanics," though it would not be any better engineering.

As a matter of fact the distance a body will fall in a second or in any other space of time has nothing whatever to do with the problem *so long as the machine stays up*. When it doesn't, the matter may become of absorbing interest.

This 250-pound thrust is, according to the data given, exerted at the rate of 35 miles per hour or about 3050 feet per minute. This has to be done to keep the machine afloat. The effective work "utilized for propulsion and support" is therefore $3050 \times 250 = 753{,}500$ foot-pounds per minute, or about 23 horsepower. This would indicate either that the propellers are far more efficient than usual types of air-handling apparatus, or else that the power delivered by the engine is considerably more than 30 horsepower.

Franklin, Penn. J. A. FOOTWICK.

[The 23 horsepower thus calculated is that actually delivered by the 35-horsepower engine. The theoretical thrust required is probably much less than 250 pounds and so the theoretical horsepower necessary to keep the machine "afloat" is also probably much less than 23 horsepower. It is in this ratio of the theoretical power to that actually required that the inefficient method of propulsion is involved. A sane method of figuring the theoretical horsepower, it appears to us, would be to consider the vertical distance through which the air is moved by the angularity of the planes and the weight sustained.—ED.]

A Precision Slide Rule

When I first read A. N. Lurie's article, Volume 32, page 1034, on a precision slide rule, describing a device of his own, which he believes will make a more accurate and desirable tool, I was struck by its real simplicity and apparent usefulness. I wondered why so bright a man as Colonel Mannheim should have neglected to use so simple and well known a device, but a little consideration soon showed me its defect.

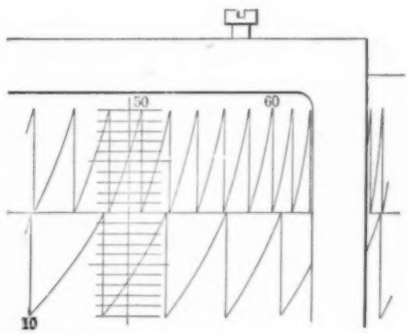


FIG. 1. THEORETICALLY CORRECT DESIGN

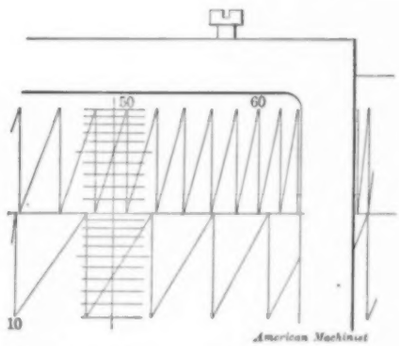


FIG. 2. A PROPOSED SIMPLER DESIGN

The improvement proposed by Mr. Lurie is destined to be used only where the accuracy of the ordinary slide rule is insufficient. It is therefore of vital importance that these improvements be such as are based upon correct theoretical principles and performed with the utmost technical accuracy. Otherwise, such a refinement is worse than useless.

The way Mr. Lurie makes use of the principle of interpolation would be right, if the slide rule in question were an addition and subtraction rule and the lengths between two major divisions in direct proportion to their mathematical values. With the logarithmic slide rule, however, these lengths are not in straight mathematical, but in a logarithmic proportion to their respective mathematical equivalents and this, of course, holds also for the very smallest subdivisions, such as proposed in Mr. Lurie's article. The error committed by neglecting this would doubtless be greater than that of direct readings and guessing of the third and fourth digit.

There is one sure method to overcome, in a scientific way, the error of Mr. Lurie's device, but this would mean a partial renunciation of its original simplicity. Fig. 1 illustrates clearly the principle, which consists in drawing the diagonals between two major divisions, not as straight lines, as Mr. Lurie does, but as curved lines, whose curvature should be carefully determined according to the logarithmic principle of the whole slide rule. This curvature would be different at every point of the scale and consequently difficult to produce. There is perhaps another scientific method which could help to overcome the error of Mr. Lurie's precision slide rule. I say "perhaps" because I could not tell offhand whether or not it is absolutely correct. I simply indicate the principle by Fig. 2, leaving it to others to study the problem and perhaps to let us know the result of their investigation. In the case of Fig. 2, the horizontal graduations on the runner glass, which intersect the hair line at right angles and are supposed to divide the diagonals between the perpendicular major divisions into ten parts, are not spaced equally but in logarithmic progression, beginning at the bottom. The diagonals are, of course, in this case, straight lines. I have good reason to believe that by this method the readings on the hypotenuses of the triangles are likewise in logarithmic proportion. If this theory were correct, or its accuracy well within the limits of accuracy of the dividing instruments, etc., it would not be any more difficult to make this slide rule than it would be to divide Mr. Lurie's, as only the four sets of graduations of the runner glass would have to be changed, although they were all four exactly alike.

EUGENE MESSNER.

Würzburg, Germany.

Concrete Floors

Referring to the editorial on page 279, "Do Workmen Object to Concrete Floors Because They Are Hard, or Because They Are Cold?", I built an addition to our plant several years ago, two stories, 50 feet wide by 220 feet long. The builders urged me to put in wood floors, claiming that the bare concrete would be objected to by the workmen, but I could not see it that way and wished to exclude all combustible material and carry no insurance.

At the start I found, as had been predicted, that the men complained that the floors were cold, but thermometer test showed that they were actually no colder than the wood floors in the old shop.

After a few months the complaints ceased and gradually the boards which the men provided in front of the machine tools and vises, disappeared. No one now ever thinks about the floor except occasionally a new man who never worked on a concrete floor calls for a board to stand on for a week or two.

As the shop is well heated, the upper floor must be at the same temperature as the air. The lower floor is several feet above the ground level and was filled two feet with dry cinders. On cutting into the concrete it is found to be perfectly dry.

The idea that a concrete floor must be cold is due solely to the fact that it is a better conductor of heat than is wood. When the hand is placed upon a concrete surface it feels cold and stays cold, whereas the wood being a poor conductor, is quickly warmed upon the surface by the hand.

A workman seldom stands long enough in exactly the same spot for his feet to warm the floor boards, so, as we have noted, the notion that concrete is uncomfortable is soon overcome.

The case is entirely different in a shop that is allowed to become extremely cold over night or on holidays. The steam may be turned on and the air warmed up before starting, but the floor will continue very cold for a long time where a wood floor would quickly attain a surface temperature like that of the air.

We have found the concrete shop, although having an unusual amount of window area, to require less than one-third the heating surface per cubic foot as the old brick and timber shop. In the offices we had the floor surface troweled smooth and then covered with linoleum over a heavy coat of liquid glue, using 60 gallons of glue to a surface of 4000 square feet. It was predicted by the linoleum people that the "dampness" in the concrete would loosen the glue, but they were dead wrong. The linoleum, after three years, seems part of the concrete. It has the firmness of stone with an almost rubbery feel under the feet. It wears like iron, being much more durable than maple, has an elegant appearance and is practically fireproof.

Our concrete side-walls or pilasters, are 12 inches thick and after weeks of steady rain, are perfectly dry on the inside.

We have no trouble whatever in bolting down machines, but it does take a lot more time to drill a hole for an expansion bolt than it does to bore in wood for a lag screw. We recently set up a large drawing press weighing 20 tons, the drawings for which called for 12 deep 1½-inch foundation bolts. We set this machine directly upon the 9-inch thick reinforced concrete floor and used large expansion bolts, and it is as solid as could be desired.

One serious objection to the concrete floor for machine shops that I have never seen in print, is that there is considerable breakage of iron castings dropped by the men, which would be uninjured if dropped on a wooden floor. Also that, where heavy work is done, the concrete surface in time gets badly chipped and worn and, particularly on upper floors, which are part of the main structure, cannot be relaid.

Plainfield, N. J. S. W. RUSHMORE.

Drafting Room Systems

I have read E. A. Hart's article on page 205 with particular interest, inasmuch as this system with certain slight modifications is the one in use in our shop, and is giving us greater satisfaction than any other we have tried.

I think I can suggest an improvement, however, over the method described of recording the location of the various prints issued.

Under the system in use in our shop, we keep in loose-leaf binders of the size of the several standard drawing sheets, one print of each drawing, known as the "Record Print," and each person to whom a print is issued, is required to sign his name and date of receipt on the back thereof, as an acknowledgment of receipt. When a print is superseded and a new one issued, the old prints are gathered up and destroyed, and the name of each person turning in an old print is crossed off the list, and he is required to sign the new "Record Print," if a new print is issued to him.

The advantages of this system over the one described in Mr. Hart's article, are that it does away with keeping a separate card-index record of prints issued, which in itself is a great saving, and that by requiring each one to whom a print is issued to sign in person for it, any dispute arising as to whether or not the proper prints have been issued to the workman, is settled quickly and conclusively.

Philadelphia, Penn. T. H. HARRIS.

Wet or Dry Grinding?

I read from time to time serious discussions of the merits and demerits of wet and dry grinding, and now on page 275 the question is again discussed in connection with high-speed steel.

This whole discussion is caused by the use of, not *grinding* wheels, but *heating* wheels.

The wheel commonly used is no more fit to grind tools than any heat-producing means would be; we might as well discuss the propriety of heating the tool in a high-temperature flame, with or without water. In the light of the facts it would be just as sensible as to wonder why some can grind high-speed steel "wet" and some cannot.

The explanation is simply that some use better cutting wheels than others, there is no mystery about it. There are plenty of grinding wheels that will grind high-speed steel or any other steel in water and not injure the edge; but should they be installed in any works today it is my belief that they would be condemned and thrown out the first day of their trial. This, not because they are not the right wheels for the work, but because they are not the right wheels for the people who use them.

The success of a grinding wheel depends principally upon the real, not the imaginary knowledge of the user. When users of tool-grinding wheels have real knowledge they will know that the right wheel is one so soft that a tool can be ground in an instant, with so little pressure that it cannot be weighed. They cannot, however, make the right wheel successful until they are willing to admit this.

I do not believe there is one grinding wheel in use today grinding tools that is suitable, and I do not believe that workmen would be willing to use a suitable wheel correctly.

They *will "bear on,"* when they should *hold back.*

Custom and tradition are very sacred to most workmen, while advance and success are secondary. Light, however, must finally illumine the minds of all, and then the grinding wheels that will be used for tool grinding, would, if tried today, be worn down to the spindle in a few hours. The right grinding wheels are ready and waiting for all, but all are not ready to use the right wheels in the *right way.*

Grinding with water is right for all kinds of work. Grinding dry is wrong. Grinding with the grade of wheel now in use for tool work is wrong, whether wet or dry; but if you persist in grinding with the popular grades of wheels then you had best grind dry. You will damage the tool in either case, but less when dry.

Worcester, Mass. C. H. NORTON.

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Contents

PAGE

Effect of Reorganization in the Canadian Rifle Factory 527
The Angle and Lead of Herringbone Gears 530
Removing Grease with Soda 530
The Effect of Phosphorus on Steel 531
Mean Effective Pressure of Air Compression 532
The Desirability of Model Machines 533
Trend of Steel Specifications to Meet Present Requirements 534
How I file my AMERICAN MACHINIST 539
Dimensions in Vulgar Fractions Again 540
Why Have Ball Bearings Been a Failure? 541
Special Machines for Making Large Spherical Bearings 543
Design of Pocket Sheaves for Cable Chain 545
Winding Coil Springs in a Lathe 546
Design and Construction of Four 9000-horsepower Turbines 547
New Customs Duties for American Machinery 550
Some Rotary Milling Operations 552
On Intelligent Employers 554
Letters from Practical Men:
A Repair for Worn Tang Slots in Drill Press Spindles .... About Etching Tools .... Socket Chucking Device for Short Drills 555
Discussion of the Previous Question:
Hardening Ring Gears .... Mistakes Made by Draftsmen .... Coöperative Industrial Education .... A Milling Machine Turret .... Why are Pyrometers Discontinued? .... Training of Trade School Teachers .... Hardening High-speed Steel .... Financial Mechanics of Aviation .... A Precision Slide Rule .... Concrete Floors .... Wet or Dry Grinding 556-560
After the Machine Is Sold 561
The Language of the Shop 561
New Tools and Machine Shop Appliances 563

American Machinist

Editorial

After the Machine is Sold

After a manufacturer has built a good machine and turned it over to the customer, knowing that it can do all that he claims for it, the easiest and most natural thing to do is to forget it and devote all our energies to the building of new machines. But the experience of many points to the conclusion that this is not the best way.

When the machine is installed it too often happens that the man in charge is not over enthusiastic, and while he does nothing to injure it, he has no interest in seeing that its production is all that it should be, to put the case mildly. The output may be enough better than by previous methods to satisfy the purchaser, so that there is no protest and the maker continues in the fond delusion that the machine is doing as well as others that he knows of. So he lists the purchaser among his references in blissful ignorance that it may do him more harm than good.

A particularly aggravating case of this kind recently came to our notice where an investigator, who was well up on the apparatus in question, called at a factory listed as a reference, to be met with the statement that it was not being used except for small work. An urgent request to see it was rewarded by the sight of two young boys puttering around with the apparatus, doing a small class of work, but utterly failing to bring out half of its possibilities, because they had never been properly instructed in its work.

So the visitor asked if he might use the apparatus a little and utterly astonished both the boys and the foreman as to what could be done with it by a little intelligent handling.

Here was a case where the maker supposed good work was being done, else he would not have used the name as a reference, yet a prospective customer might have easily obtained an entirely erroneous opinion as to its merits and would certainly not have been encouraged to buy an apparatus which was damned with such faint praise.

Many manufacturers are recognizing these conditions and are employing skilled representatives, or demonstrators, who not only see that new machines and operators are started on the right road, but also visit shops where machines are in use, to see that they are doing all that should reasonably be expected of them.

This is the outcome of the old time "trouble man" who responded to "kicks" from any point of compass and straightened out tangles that were bad for all concerned. In some respects his task is more difficult than before and requires more diplomacy or tact. For, instead of waiting to be sent for, he must go into shops where the machine is doing satisfactory work and yet where the operators are not driving the machine to its capacity.

Most shops, surely all progressive shops, will welcome a demonstrator who can show them how to improve the quality or quantity of their output from any machine and these have proved paying investments when the organization allows of it. They are of course more necessary on special machines such as gear-cutters, semi or full automatics and similar machines, but even the old engine lathe is capable of better handling in most cases and it is difficult to draw the line.

When a prospective purchaser goes to a shop that has been watched over by a good demonstrator, he receives information and impressions that go far toward making a customer and there can be no doubt that it will pay most makers of machines to keep track of their product after it has been sold.

The Language of the Shop

Every industry has its own language—words and expressions applying to its tools, its processes and its products. To anyone outside of the trade many of these words are as meaningless as if they belonged to a foreign language; and other common words are so distorted from their original meaning as to be utterly confusing to one uninitiated.

Imagine a school teacher whose knowledge of dogs is confined to her pet Pomeranian and an annual visit to the dog show, endeavoring to understand the various meanings of "dog" in the language of the machine shop.

Machinists are fond of applying the names of common well known objects to oddly shaped castings or machine parts

that in some way suggest the familiar objects. We have seen parts that were called "the lobster," "beer mug," "bean pot," etc., and no one can attempt to guess the number of machine-shop creations that have been dubbed "porcupine."

All this is a question of names and names can be easily learned if anyone will try, but there is another use of language in the shop, that is not as readily appreciated by the outsider. An incident will illustrate. In a certain trade school the boys had written compositions, and one had used the expression "perfectly round." The teacher criticized this severely, taking the academic position that a thing was either round or it was not round. The boy, who had had sufficient shop work to grasp the idea of degrees of accuracy, held that the expression was not wrong from the shop viewpoint. A man who had spent his life in the shop and was an enthusiast in working for trade education happened to be in the class as a visitor. He was appealed to, to arbitrate the good use or poor use of the expression "perfectly round." He decided at once in favor of the boy, pointing out that absolute roundness exists only in the abstract, and that in the pieces of iron and steel and brass as they exist in the shop there are many degrees of roundness.

A given dimension, say, three inches, can well be looked upon as a limit; the permissible variation from this limit depends entirely upon the class of work that is being done. On some kinds of machinery, where a two-foot rule is used instead of a more refined measuring appliance, ⅛ of an inch may be as close as there is any need of approaching the limit; that is, for that shop and for that work, three inches may mean any dimension between 2⅞ and 3⅛ inches. In another shop 1/64 of an inch may be the permissible amount of variation from the limit; and in still another one-half a thousandth may be the allowable variation.

Such degrees of accuracy, such approximations, such permissible variations from the limit are known to the shop and the shop has a language of its own to describe them. Qualifying words like, "scant" and "full" apply to measurements; "snug," "close" and "free" apply to fits; and even more elaborate qualifying expressions as "a red hair shorter" have a meaning in certain shops, although it might be very difficult to interpret these expressions in thousandths of an inch.

We are neither condemning nor commending the use of such expressions, but merely pointing out that they exist, and that there is a real language of the shop. Teachers and would-be teachers of trade schools can well take notice and ask, do I know the language of the trade that I am teaching? Do I know the language that my boys will have to use when they get into the shop?

Pennsylvania Railroad Apprentice School

The Pennsylvania Railroad Company has just established a unique railroad school at Altoona, Penn. The Pennsylvania State College is to send professors to Altoona two days a week to give instruction to apprentices employed in the railroad shops in special quarters, which have been constructed for the school rooms.

The plan with which the Pennsylvania Railroad Company is experimenting is to educate apprentices along the lines of work which they are following, with the view that this instruction will result in their becoming better and more efficient workmen. At the same time, their records in the school will give the employing officers a better opportunity to judge of their qualifications. From the ability shown in the school and with the records in the shops, their fitness for advancement in the service can be determined. The professors will make a monthly report on the progress made by each one attending the school.

The membership of the first class will be composed of apprentices of the fourth year who have shown ability in their work and a disposition to better their education. It will be optional with the young men whether or not they will take the course, but after entering the school, attendance will be compulsory. The first class will be limited to thirty apprentices.

The course of instruction, while not definitely determined upon, will, in a general way, consist of the various elementary principles of mechanics, mechanism and materials, and simple computations based upon these subjects. The school was opened on March 1, and will continue in session until the first of June. Sessions will be held on Tuesdays and Fridays, two hours each day, from one o'clock to three o'clock.

Passing of the City Shop's Power Plant

We read at intervals statements from artist-architects and others about "the city beautiful" and "the city planned"—though perhaps our ideas may be very hazy as to just what is meant aside from spending a lot of the taxpayers' money. Professor Jackson, in a paper read before a meeting of Boston engineers, gave a suggestion to these "city planners" that is worthy of serious consideration. Its adoption would mean the passing of individual power plants for city shops. We quote Professor Jackson's suggestion:

"Much is now being said of 'city planning.' Some of the proposals seem to be founded on pure altruism, but others are obviously founded on economy. The city planners of crowded industrial cities have an opportunity which joins economy with altruism in studying the applicability of electrical power from centralized generating stations to large and small industrial establishments. There is here an opportunity for the betterment of crowded larger industrial cities that ought not to be overlooked. It has its possibilities also in the smaller industrial cities. The possibilities are larger and more real than appear at first view. I lay this before you as one of the most important and desirable ways in which the proved applicability of electrical power to industrial establishments may be utilized for the betterment of crowded factory areas."

PERSONALS

Items For This Column Are Solicited

A. W. Waern, engineer of the machinery department of the Bethlehem Steel Company, has joined the firm of Joseph H. Wallace & Co., New York City, as consulting engineer.

Howard E. Coffin has recently been made vice-president of the Hudson Motor Car Company, Detroit, Mich. Mr. Coffin formerly held a similar office with the Chalmers-Detroit Motor Company.

Alfred H. Knight, until recently assistant professor of mechanical engineering at the University of Michigan, has entered the employ of the Packard Motor Car Company, Detroit, Mich., as carriage-chassis engineer.

J. E. Fefel, formerly connected with the sewing-machine industry, and more recently vice-president of the United States Selling Machine Company, New York, has beer appointed assistant superintendent of the automobile department of the New Departure Manufacturing Company, Bristol, Conn.

OBITUARY

James Alldis, one of the principal owners of the Excelsior Needle Company, Torrington, Conn., died on March 18. He was 71 years of age and besides being a manufacturer, was prominent in public affairs of his State.

George C. Gill, general superintendent of the printing press manufacturing plant of R. Hoe & Company, New York City, died on March 2. Mr. Gill was 71 years old, and had been connected with the Hoe works for 56 years.

Thomas McK. Laughlin, assistant treasurer of the Jones & Laughlin Steel Company, Pittsburg, died on March 11. Mr. Laughlin was connected with his company for a number of years, and was otherwise prominent in the Pittsburg district. He was but 35 years of age.

New Tools *and* Machine Shop Appliances
Showing New Ideas *in* Machine Shop Equipment *that* make *it* possible *to* do better work at a reduced cost

Three New Grinding Machines

The illustrations show improvement in the line of grinding machines made by the Springfield Manufacturing Company, Bridgeport, Conn. Fig. 1 shows a dry grinder carrying two 4x24-inch wheels,

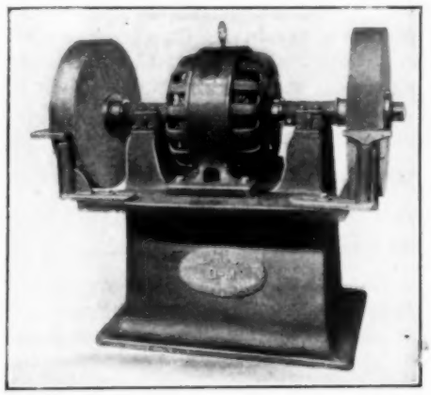


FIG. 1. MOTOR-DRIVEN DRY GRINDER

driven by a Westinghouse alternating motor, and having self-oiling bearings 2 inches in diameter by 8 inches long. Using a motor of this type obviates the necessity for expensive starting apparatus, regular knife switches being all that is required. This machine can, however, be furnished with an inclosed motor if preferred, or with a motor of the direct-current type.

Fig. 2 shows the automatic oscillating surface grinder, in which the table is driven either with a rack or screw, as may be preferred. The wheel is 20 inches in diameter by 12 inches wide, and is carried on a spindle in two phosphor bronze boxes, which oscillate in the saddles mounted on the uprights or housings. This oscillation is obtained by the crank movement shown at the right, and can be regulated to suit the width of the work being ground. A centrifugal pump is shown behind the driving pulleys for supplying cooling compound to the wheel and work. The machine will grind 24 inches wide and handle work 18 inches high and 10 feet long, other sizes being made if desired.

Fig. 3 is another grinder of the planer type, which is provided with two motors. The grinding wheel is driven by a 3-horsepower motor, while the other, which operates the driving mechanism, is 2½ horsepower. The wheel is 12 inches in diameter, by 2 inches face, and the machine shown handles work 24 inches wide and 8 feet long, but is made in other lengths, from 4 to 12 feet.

ANY new or improved machine or shop appliance of interest to our readers will be illustrated and described in this department.

A full and more detailed description will be given—when of special interest and it appears here before being sent elsewhere.

ALL descriptions appear in all four editions of the paper—Weekly, Monthly, Weekly English and Weekly German.

Ventilating Outfits

While we do not half appreciate the advantages of proper ventilation, its importance is becoming much more generally understood than formerly, and the results are highly beneficial. The B. F. Sturtevant Company, Jamaica Plains, Mass., is building small ventilating sets

FIG. 1. COMPACT VENTILATING OUTFIT

as shown in Fig. 1, which are complete with a motor and a multi-vane blower, as can be seen. These can be placed in any convenient position, driven from a lamp socket and afford a positive method of exhausting vitiated air, or of introducing a supply of fresh air from the outside.

They are equally applicable to shop or office, and Fig. 2 shows a use to which they can be put in practically every shop.

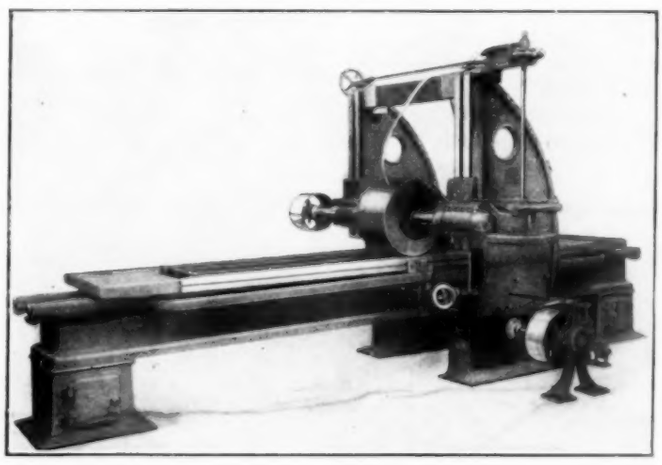


FIG. 2. AUTOMATIC OSCILLATING SURFACE GRINDER

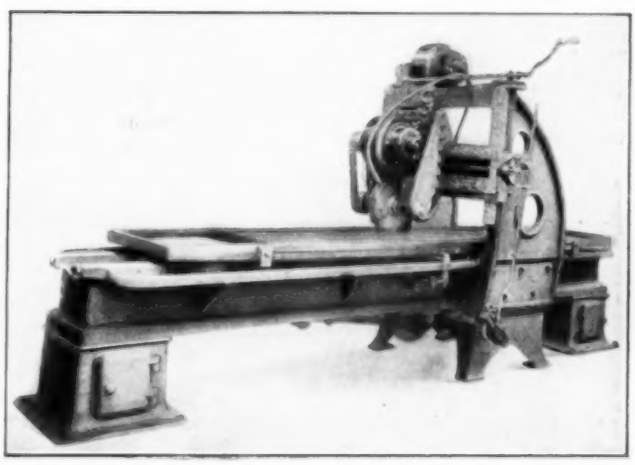


FIG. 3. PLANER TYPE GRINDER WITH TWO MOTORS

FIG. 2. A GOOD SHOP APPLICATION

With an outfit of this kind in a shop or other toilet room, the air is rapidly changed and many of the objectionable and unhealthy features are entirely done away with. When we consider that every person should have at least 30 cubic feet of fresh air every minute, it is easy to see how we fall short of it in too many instances with the result of reducing the efficiency of the workman even if we do not directly contribute to his lack of health in some cases.

Le Blond Manufacturing Lathe

The accompanying halftones illustrate a manufacturing lathe recently brought out by the R. K. LeBlond Machine Tool Company, Cincinnati, Ohio. The engravings also serve to illustrate the construction of the geared head regularly supplied for this company's line of heavy-duty engine lathes illustrated at page 427, Volume 32, Part 2. The machine is equipped with multiple automatic length stops and multiple cross-feed stops. These features, together with its ample driving power and general rigidity, adapt it to the duplication of shafts and other work having one or more shoulders, and at the same time it has the advantage of the regular lathe construction for all other kinds of lathe work.

Fig. 1 illustrates the lathe in the 21-inch size, fitted with pan bed, pump, plain rest and plain geared feed. The machine is also supplied with screw-cutting quick-change gear mechanism and three-step cone and double-friction back gear as described in the article referred to above. It is built in seven sizes, from 17- to 33-inch swing.

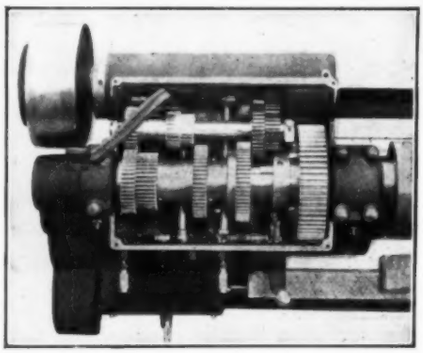


FIG. 2. INTERIOR OF HEAD SHOWING ARRANGMENT OF GEARING

The headstock is of closed box construction braced with cross ribs and forming a reservoir allowing the gearing to run in a bath of oil. Oil gages are provided for determining the hight of the lubricant. The spindle speeds are 12 in number, covering a carefully selected range, and are obtained with a single-speed driving pulley permitting the machine to be driven direct from the line shaft. The driving mechanism consists essentially of two shafts, the spindle and two sets of sliding gears with a back gear of the design usually found on friction-head lathes. The driving pulley is equipped with a large friction clutch operated by a shifter bar extending the length of the bed. This clutch is used for stopping and starting the machine and permits direct driving from the line shaft. A friction brake is operated by the same movement that disconnects this friction, enabling the operator to stop the lathe quickly when required.

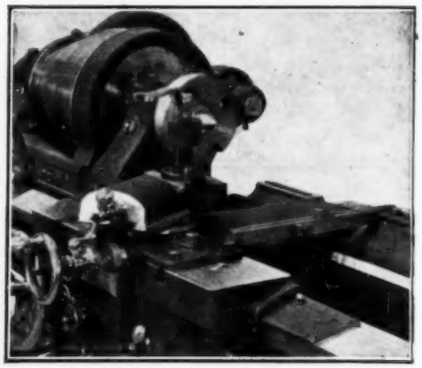


FIG. 3. MULTIPLE CROSS-FEED STOPS ON CARRIAGE

Automatic Buffing Machines

This machine has been developed to handle comparatively plain buffing and to be operated in connection with any standard buffing machine or head. As illustrated one of these machines is at work on the cylindrical shell of a portion of an acetylene generator such as is carried on automobiles. This is shown at the left in contact with the buffing wheel and its operation is easily understood.

Power comes to the machine from the vertical shaft which revolves the work and at the same time operates the crank movement which moves the work back and forth past the buffing wheel. The various adjustments are clearly shown and easily understood. It is claimed that the uniform pressure against the wheel insures a much longer life than in hand buffing, which adds to the economy of

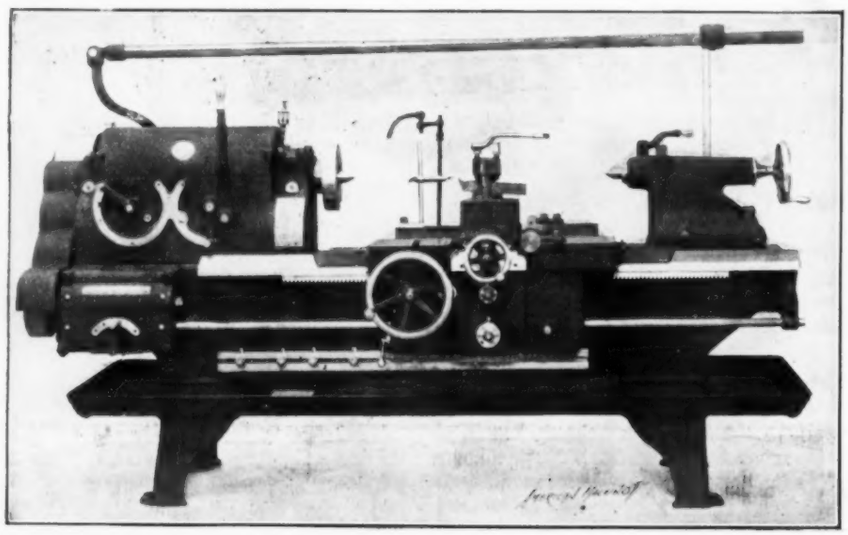
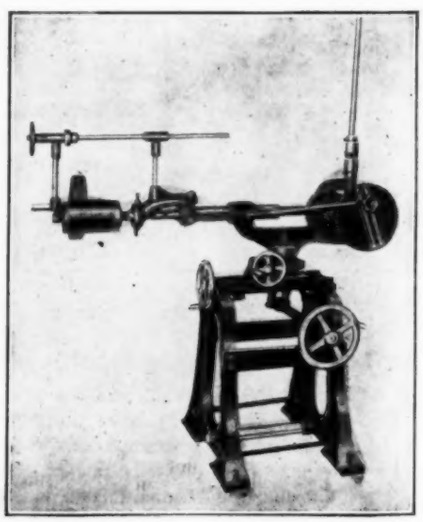


FIG. 1. LE BLOND MANUFACTURING LATHE



AUTOMATIC BUFFING MACHINE

operation. Other styles of machines are made especially adapted to various kinds of work, by the Automatic Buffing Machine Company, Buffalo, N. Y.

Shaper with Novel Feed Mechanism and Table Support

The engravings illustrate a 24-inch shaper built by the Queen City Machine Tool Company, Cincinnati, Ohio, in which machine an interesting feed mechanism and table support are incorporated; these features will also be applied shortly to the 16- and 20-inch shapers of the same make.

The general view, Fig. 1, shows the table support clearly and also the arrangement of the feed mechanism, although the construction of the latter is brought out more clearly in the line engraving Fig. 2. With this automatic feed 16 changes from zero to full feed or reverse (the range on the 24-inch machine being from 1/64 to ¼ inch) or to and from any number of notches in either direction, can be made instantly with safety and precision while the machine is running, by means of the cam shown at the end of the cross-feed screw. The feed and distance rods act automatically as the hight of the rail is changed. The friction shown provides for sufficient power for feeding but not enough to break any of the parts in case the workman feeds on the cut or allows the saddle nut to strike against the rail at either end. To keep the feed on return stroke the plunger is lifted out with the lever on the feed rod and it will then travel automatically to the opposite side of the plate and drop into the hole shown.

The table support as illustrated in Fig. 1 has complete adjustments, and is self alining and self adjusting. The support consists, as shown, of a shoe with gib fitting a ledge on the bottom of the table, the latter when elevated or lowered adjusting the supporting shoe up or down upon its bracket; when adjusted for hight the support is securely clamped by the two screws shown.

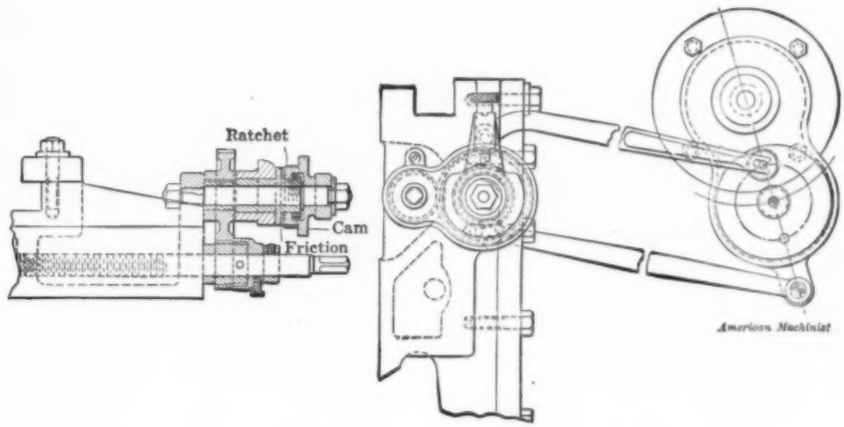


FIG. 2. FEED MECHANISM

Hydraulic Bending Machines

Those having large pipe, structural sections, automobile parts, metal parts, and similar sections to bend, will be interested in the two new bending machines illustrated herewith, just brought out by the Watson-Stillman Company, New York City.

The frames and cylinders are made of cast iron, the cylinders having copper lining. The rams and bending pins are of machinery steel, and a positive stop is provided in both machines to avoid the ram passing beyond a safe limit.

Fig. 1 shows a machine capable of exerting a power of 25 tons under a hy-

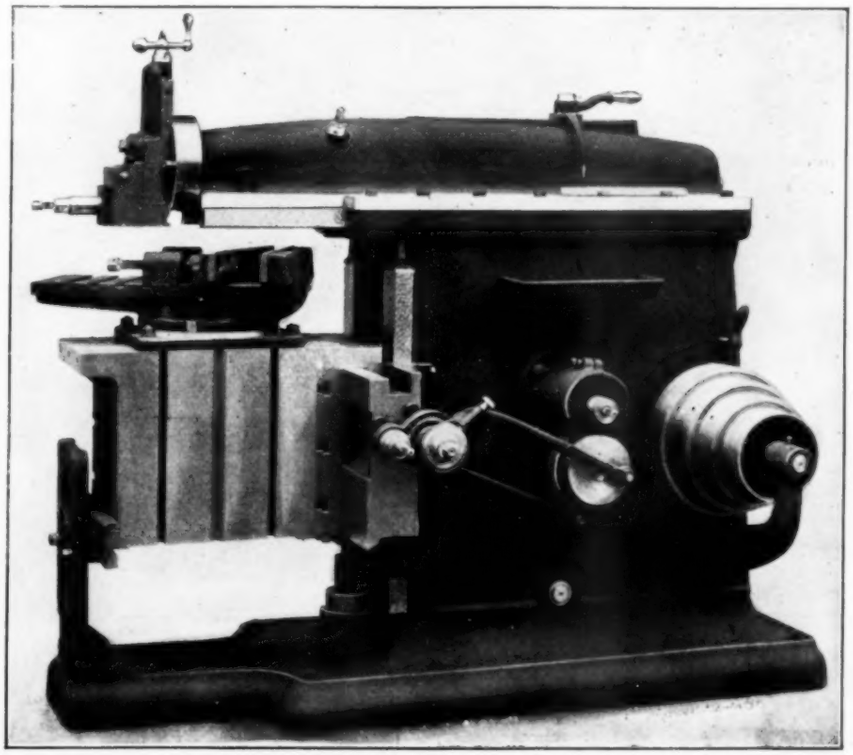


FIG. 1. 24-INCH SHAPER WITH NEW FEED DEVICE AND TABLE SUPPORT

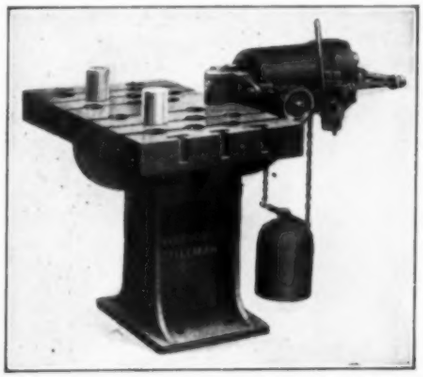


FIG. 1. 25-TON HYDRAULIC BENDING MACHINE

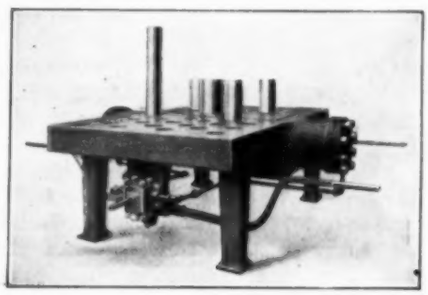


FIG. 2. 30-TON HYDRAULIC BENDING PRESS

draulic operating pressure of 2000 pounds per square inch. The table is 2 feet long by 3 feet 4 inches wide, and has 18 round holes staggered in rows placed in symmetrical position in respect to the ram. Round pins 2½ inches in diameter can be placed in these holes, and the work may be further held in place by bolts set in any of the key slots. The ram has a travel of 8 inches, brought back by a counterweight, the operation of the ram being controlled by a stop and release valve at the side of the cylinder.

Fig. 2 shows a much larger machine,

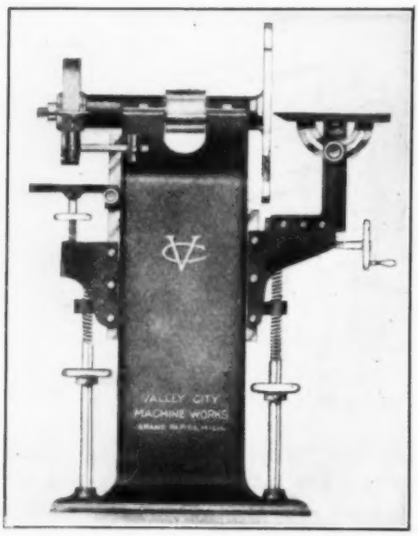


FIG. 1. COMBINATION SURFACE AND TOOL GRINDER

capable of exerting 30 tons pressure. The table of this machine is 6 feet long by 4 feet wide, possessing two opposed 7-inch cylinders of 12-inch stroke, arranged to operate in either direction.

As shown, this table has 21 holes in each side of the ram, the movable pins, 4½ inches in diameter, being interchangeable.

The ram works in machined guides, covered to prevent scale or dirt reaching the contact surfaces.

As in the smaller press, the cylinder heads are removable, and provided with air passages to permit drainage.

Mica Annealing Mixture

A new product called mica annealing mixture has been placed in the market by the United States Mica Company, Chicago, Ill., which is claimed to possess advantages over charcoal, bonedust, and similar materials for annealing tool steel.

This mixture is noncombustible, thus permitting long usage, and mica being a nonconductor of heat, the steel, when covered with the mixture, cools slowly and evenly, giving the steel a uniform degree of softness. As mica also is a nonabsorbent, it is not affected by the elements, by acids, gases, or steam, and the steel comes out clean with no scale or oxidation. The material is used in an annealing box in a similar manner to any other annealing mixture, and is reported in use by some of the leading tool-steel producers in the Pittsburg district.

Two Grinding Machines

These illustrations show two grinding machines brought out by the Valley City

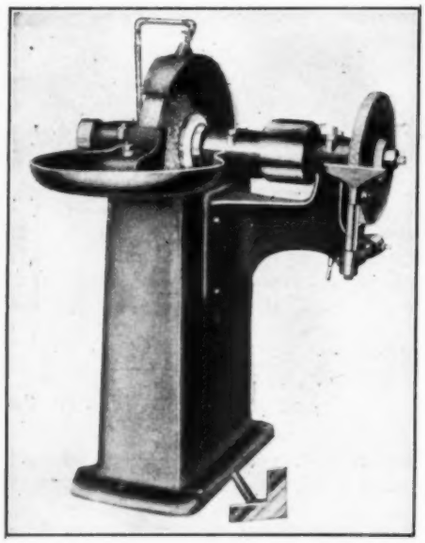


FIG. 2. COMBINATION WET AND DRY GRINDER

Machine Works, Grand Rapids, Mich. Fig. 1 is a combination surface and tool grinder, which can be used in many ways. The table on the disk side is 10x18 inches and can be tilted to any desired angle, and has both vertical and side adjustments. The grinding disk is 18 inches in diameter. The surface table is 20x8 inches, and has a vertical movement of 6 inches. The upper table has a micrometer adjustment.

Fig. 2 shows a combination wet and dry grinder, which needs no description.

Adjustable Die and Holder

One special advantage of a die made in two parts as indicated in Fig. 1, is that it can be readily sharpened after hardening, and also reground at any time it becomes dull from long use. Instead of depending on the spring of the steel, the two halves come together on a pin with large bearing surfaces, so arranged as to hold them firmly against side movement and yet allow perfect freedom of adjustment.

A taper groove in each half of the die allows the tapered point of an adjusting screw to hold them apart any distance required, to secure the proper cutting size.

These dies can best be held for hard work in such a die holder as shown in Fig. 2, the taper-pointed screw at the top serving to give the right setting of the die while the clamping screw at the bottom holds the die firmly in place. It is claimed that the ease of sharpening the die makes it possible to use a wrench with shorter handles, as they require less power than a solid die.

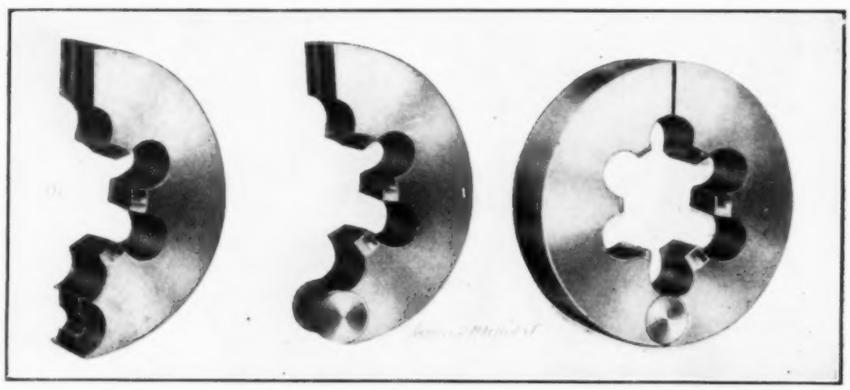


FIG. 1. TWO-PART DIE SHOWING JOINT USED

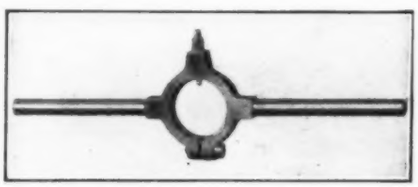


FIG. 2. HAND WRENCH FOR DIE

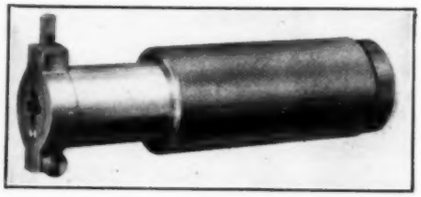


FIG. 3. DIE HOLDER FOR LATHE

For use in screw or turret machines, other holders are provided similar to the elastic die holder shown in Fig. 3. This is for use in the lathe on small work,

where it can be held by hand, but a very similar holder is used for other work.

These dies and holders are made by the Remington Tool and Machine Company, Boston, Massachusetts.

Hack Saw Frames with Gutta Percha Handles

The Simonds Manufacturing Company, Fitchburg, Mass., is now making their straight-cut hack saw frame No. 39 for 8-inch blades stationary and No. 41 adjustable for blades from 8 to 12 inches, inclusive, with black gutta percha handles, having checkered sides. The handles resemble regular saw handles, and reach from the frame proper down to the saw itself. The blades may be faced four ways.

Steel Collapsible Horse

The illustrations show a recently patented form of steel horse, or trestle, that seems to possess interesting features. It is manufactured in six sizes, ranging from 19 inches high by 20 inches long to 37 inches high by 35 inches long. Angle iron is used in its construction, thus insuring rigidity and strength. As seen in Fig. 2, the collapsible feature is that legs fold up when the trestle is not in use, making it handy for transportation and requiring a minimum space for storage. The top bar has two holes for the purpose of holding boards rigidly in case it is desired.

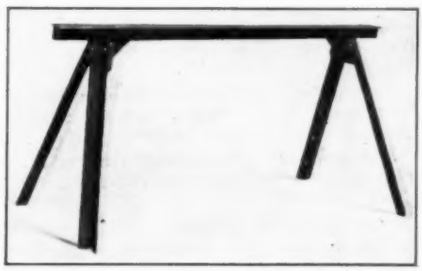


FIG. 1. STEEL COLLAPSIBLE HORSE

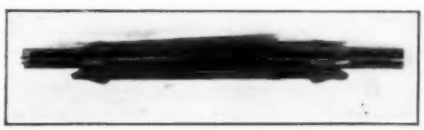


FIG. 2. FOLDED UP

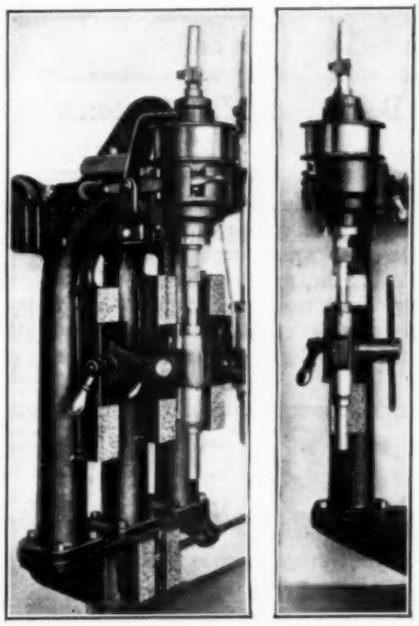
S. M. Hildreth Company, 2 Rector street, New York City, are marketing this product.

Tube Polishing Machine

John C. Blevney, Newark, N. J., has arranged his belt polishing machine to handle brass or steel tubing up to 3 inches in diameter. This retains the grinding belt running over a cushion belt and a long platen enables the tubes to be handled very conveniently. By placing the tubes at an angle, they are turned and fed under the belt by its own action. The table also moves back and forth under the belt. The general principle is similar to the machines we have already illustrated.

A Novel Tapping Attachment

The illustrations show side and front views of a new combination drilling and tapping machine made by H. G. Barr, Worcester, Mass. This machine is automatically reversible in both directions when being used for tapping, and this is accomplished by the regular lever motion as in drilling.



NOVEL TAPPING ATTACHMENT

At first this seemed impossible, but the matter was very simple, after all. This makes possible very rapid and accurate tapping on multiple work. It obviates the necessity for "tapping chucks" and introduces a convenient and profit-making feature at one and the same time.

This is known as the "style 'A' tapper" and is shown attached to a three-spindle drilling machine. The tapper consists of the post, spindle and pulley, complete, and can be attached to one or more spindles, as required. The binder handle shown at the right in the front view, holds a slide which engages the reverse motion when brought forward; when this is pushed back all parts are idle except the pulley and spindle, these being used only when a reversing spindle is required.

When used as a tapper, the upper collar is set to reverse the spindle at the depth required and the lower collar is set to reverse the spindle to the right-hand motion just after the tap is backed out of the work, this last reverse being accomplished by the natural upward motion of the hand lever at the end of the upward stroke. Both these reverse motions are accomplished by the contact of the collars with a quill having a longitudinal motion, thus operating the reverse. The quill is held up or down by a spring-actuated lever, which gets its initial movement from the movement of the quill referred to.

Any drill chuck or "slip chuck" can be used to hold the tap. The tap runs true, and the action is rapid and positive. The tension of the spring controlling the automatic lever is adjustable by means of a screw bushing. This tension is increased to support the drag on the larger taps and reduced as required for the most delicate taps.

This size machine will tap up to 3/8 inch and drill up to 1/2 inch. When used for drilling, the slide is pushed back as stated, the set collars loosened on the spindle and a stop on the rack used for depth.

Slotting Attachment for the Milling Machine

The Kearney & Trecker Company, Milwaukee, Wis., has brought out a new slotting attachment for its milling machine, the general appearance being shown in Fig. 1.

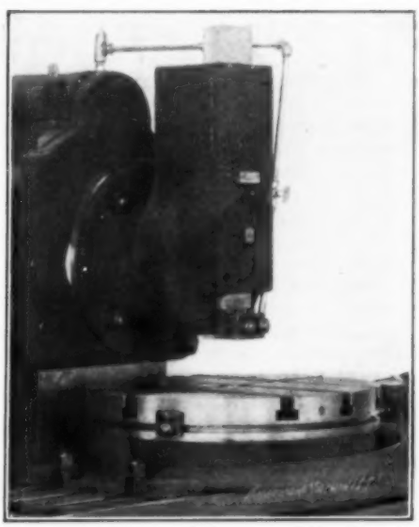


FIG. 1. SLOTTING ATTACHMENT FOR MILLING MACHINE

The details are shown in Fig. 2. The ram *A* is a rectangular steel bar, and carries at its lower end V-blocks *BB*^{1} with a hardened piece *C* to back up the tool. The tool *D* can be of any form or shape, rough or finished. This form of ram permits of a long bearing relative to its width, which insures stiffness and better alinement.

The return of two to one is effected through the driving shaft *E*, which has a T-slot cut through its front end to receive the adjustment bolt, *F*. This bolt

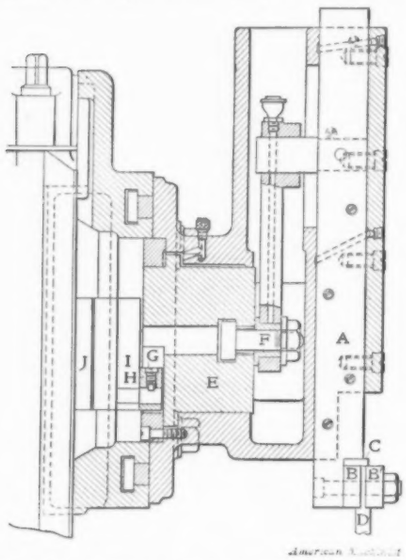


FIG. 2. DETAILS OF SLOTTING ATTACHMENT

is adjusted with a wrench, through an opening on the right-hand side. Stroke can be adjusted from 0 to 4 inches.

The driving shaft *E* has a groove *GG*¹, carrying a bronze block *H*, that is driven by the collar *I* directly on the main spindle of the machine. The center line of the driving shaft *E* is above the center line of the spindle *J*, a distance sufficient to give the quick return.

The casting carrying the ram is graduated in degrees with the zero line on the base clamped to the knee slide. This makes it possible to set the ram at work in any direction. It could be used in connection with rotary table as shown by photographs for any work requiring slotting and indexing, as, for instance, internal gears, or anything of that nature. It can also be swiveled to a horizontal position and used in connection with universal centers for similar work where rotary table is not available.

Belting of Half Cotton and Half Leather

In a discussion of lineshaft efficiency in the proceedings of the American Society of Mechanical Engineers, W. F. Parish, Jr., points out that for comparative tests made under work-shop conditions it is advisable to have the belts made up half of cotton and half of leather, thereby eliminating the effect of humidity, which may cause variations of 12 per cent. in the power delivered.

An English firm five years ago purchased a cotton belt to drive a dynamo, but this belt was not equal to the speed and power required of it, so a leather belt was substituted. It was decided to use the cotton belt on one of the main mill drives, but it was found to be much too short. So a piece of leather belt was spliced in, the whole being, when finished, half leather and half cotton. A casing was built under it, as it was low down and in a dangerous position. The manager was annoyed to find that this casing had been built too close to the belt, no allowance being made for sagging.

The dampness greatly affected the leather belt, as the drive was in a low part of the mill, but the casing under the patched belt was never altered. The length of the belt never varies whether the weather is damp or dry, and it is the best belt drive in the mill for steady work. Moisture has an opposite effect on leather and cotton, leather lengthening and cotton contracting with an increase of humidity, so that in the half-cotton and half-leather belt, the weather effect is practically compensated for.

Increasing Shop Capacities

Where More Tools will be needed

H. C. Spence will build a bottling plant at Greenville, Miss.

Fire destroyed the Dillon Automobile Garage, Dillon, S. D.

S. E. Rauh, Indianapolis, Ind., is to erect a $10,000 garage.

J. E. Roover's garage, at Camden, N. J., was destroyed by fire.

Fire destroyed the brass foundry of W. C. Baker, Amesbury, Mass.

The Farmers Association, Glenville, Neb., is to build a grain elevator.

The foundry of the Portland (Conn.) Specialty Company was burned.

Fire destroyed the cigar-box factory of Walter Rich, Hillside, N. J.

The Fort Smith (Ark.) Wagon Company is erecting a two-story addition.

The New Haven (Conn.) Clock Company will build a $25,000 addition.

The Inman Box Company, Kansas City, Mo., will erect a new factory.

The Waite Grass Carpet Company, Oshkosh, Wis., will erect a new factory.

The Citizens Ice Company, Toledo, Ohio, will erect a 100-ton ice plant.

The Dake Engine Company, Grand Haven, Mich., will build a new foundry.

R. A. Ward, of Memphis, Tenn., will install a gas plant at Mayfield, Ky.

The Bard Union Company, Norwich, Conn., will erect an addition to its plant.

The West End Thread Company, Bramanville, Mass., will erect an addition.

Authentic news is solicited for this department. Real opportunities for the sale of machinery of any kind.

D. W. Meyers, of Athens, Tenn., will erect a machine shop at Cleveland, Tenn.

B. Jahn, New Britain, Conn., die and tool maker, contemplates enlarging his plant.

Wm. J. Oliver Manufacturing Company, Knoxville, Tenn., will enlarge its foundry.

The Hanover (Penn.) Heel and Innersole Company is erecting a two-story addition.

The Richie Corrugated Culvert Company, of Ottumwa, Ia., will move to Muscatine, Ia.

The American Hand-Sewed Shoe Company, Omaha, Neb., will build a six-story addition.

The Pennsylvania Railroad will build an addition to its machine shop at Trenton, N. J.

Quick Meal Stove Company, St. Louis, Mo., will erect a stove foundry to cost $200,000.

The Burton Saw Company, Vancouver, B. C., will erect a plant in Bellingham, Wash.

The Edison Electric Company is to build a $2,000,000 power plant at Long Beach, Cal.

The Shamrock Mills Company, Winston-Salem, N. C., will build an additional hosiery mill.

The S. L. & G. H. Rogers Company, Wallingford, Conn., will build a new engine room.

New engine and boiler is to be installed in the Schuyler (Neb.) city light and water plant.

The Eastern Oil and Rendering Company, Portsmouth, N. H., will erect a cold-storage plant.

The National Car Coupler Company, Attica, Kan., is to erect two additions to its plant.

The Adams Bros. Company, Findlay, Ohio, intend to add the manufacture of motor trucks.

The Racine (Wis.) Iron and Wire Works is having plans drawn for a new three-story factory.

The Helena (Ark.) Brick Company will install additional machinery in the near future.

The Utah Produce Company, Murray, Utah, will erect a canning factory in the near future.

The Automobile Club of Philadelphia, Penn., is planning the erection of a $400,000 garage.

The Crescent Fixture Company, Grandville, Mich., contemplates extensive additions to its factory.

The U. S. Cartridge Company, Lowell, Mass., has taken out permit to build a three-story addition.

The West Jefferson (Ohio) Creamery Company has awarded contract for a two-story addition.

The Autopress Company, College Point, N. Y., is about to break ground for a new addition.

The Duncan Ladder Manufacturing Company, Lake Charles, La., will build a factory at Elton.

The Crain Pump and Lumber Company, Philadelphia, Penn., has purchased site for a new plant.

George Cotter & Co., South Bend, Ind., manufacturing specialties, will add a foundry this spring.

The Glazed Cement Sewer Pipe Company, of Tacoma, Wash., will erect a plant in Bellingham.

Philip & Mahoney, Porstmouth, Va., manufacturers of lumber, contemplate erection of a new mill.

The W. A. Newton Company, Springfield, Mass., carpenters and builders, are erecting a new factory.

The Indiana Handle Company, Vincennes, Ind., whose plant recently burned, will probably rebuild.

The Clinton (Mass.) Wire Cloth Company is said to be contemplating the erection of another mill.

The Gardner Machine Company, Beloit, Wis., is having plans prepared for a proposed new factory.

The Central Boiler and Supply Company, Grand Rapids, Mich., will build an addition to its plant.

O. L. Plauche, Plaucheville, La., is erecting a broom factory to have a capacity of 500 brooms a day.

Contracts have been let for a new foundry for the Milwaukee (Wis.) Malleable and Gray Iron Company.

The International Stock Food Company, Minneapolis, Minn., will erect a plant in Memphis, Tenn.

The Gould Balance Valve Company, Kellogg, Ia., has purchased site for a plant in Des Moines, Ia.

Woods Brothers, Des Moines, Iowa, manufacturers of traction engines, etc., will enlarge their plant.

Weaver & Wittle, Lebanon, Penn., manufacturing gasolene engines, will erect a new foundry building.

H. P. Hood & Sons, Charlestown, Mass., are contemplating the installation of a refrigeration plant.

The Meriden (Conn.) Electric Light Company is to install a new turbine and make other improvements.

The Arkansas Cotton Oil Company will rebuild its mill in Brinkley, Ark., destroyed by fire some time ago.

The Bracket Realty Company, 137 East Twenty-fifth street, New York, is to install a new power plant.

The plant of the Columbia Steel Company, Elyria, Ohio, is to be enlarged. A hot rolling mill is contemplated.

The Mt. Vernon (Ohio) Bridge Company, whose plant recently burned, will probably rebuild in Mt. Vernon.

The Hobart M. Cable Company, La Porte, Ind., manufacturing pianos and organs, will erect a large addition.

The Milwaukee Stamping Works, Beloit, Wis., whose plant recently burned, will rebuild on a larger scale.

The Rossle Brewery, Roxbury, Mass., is erecting an addition to its boiler room and will install another boiler.

Charles Zies, 318 South Fremont avenue, Baltimore, Md., will erect an addition to be used as a machine shop.

The Independent Button and Machine Company, Chicago, Ill., will erect a new factory at a cost of $30,000.

The Denver (Colo.) Gas and Electric Company will install a new 6000-kilowatt turbine and 1500-horsepower boiler.

The Canadian Mill and Elevator Company, El Reno, Okla., has let contract for the erection of a steam power plant.

Plans for a new factory for the Washington Interior Finishing Company, at Fremont, Wash., have been completed.

The Vaughan Knitting Mills Company, Reading, Penn., is preparing to rebuild its mill recently destroyed by fire.

The Greenlaw Lumber Company, Ramsey, La., has purchased site for a sash, blind and door factory in East McComb.

The Corbett-Richardson Company is to build a factory at Memphis, Tenn., to manufacture the Menges automobile.

The Wichita (Kan.) Railway and Light Company will build a new power plant, car barn, etc., at a cost of $700,000.

Ing. Roberto Zust, via Manzoni 42, Milan, Italy, is inquiring for machine tools and accessories for import into Italy.

The Hayes Manufacturing Company, Pontiac, Mich., making automobile parts, will erect a new three-story factory.

The Henry & Brown Motor Company, Los Angeles, Cal., capitalized at $12,000, will erect a garage on Grand avenue.

The Woonsocket (R. I.) Shuttle Company has awarded contract for a new building to replace the one recently burned.

The plant of the National Fibre Board Company, South Lawrence, Mass., was damaged by fire to the extent of $100,000.

An addition to the American Locomotive Company (Brooks Works), Dunkirk, N. Y., to cost $50,000, will soon be started.

Cornerstone for the new $3,000,000 plant for the Eastern American Rolling Mill, at Middletown, Ohio, has been laid.

Fire destroyed the wheel and rod shop, boiler plant and engine hoist at the shops of the Seaboard Air Line, Norfolk, Va.

The Holston Manufacturing Company, Lenoir City, Tenn., will enlarge its plant and install additional hosiery machinery.

The Santa Fe Railway Company has completed plans for a new roundhouse and machine shops at National City, Cal.

The Boston & Northern Street Railway Company is making extensive additions to South Lawrence, Mass., power house.

The Standard Bleachery, Carlton Hill, N. J., will build an addition to its factory and increase the capacity of its power plant.

The city of Los Angeles, Cal., will vote April 19 on issuance of $6,500,000 bonds for harbor improvement and power plant.

The Findlay (Ohio.) Carriage Company will increase capital stock for the purpose of establishing an automobile department.

The Seventieth Street Hygeia Company, 517-519 East Seventieth street, New York, has filed plans for enlarging its plant.

The Central Railroad of New Jersey has purchased ground in East Allentown, Penn., for the erection of a large roundhouse.

The Pennsylvania Salt Manufacturing Company, Philadelphia, Penn., has taken out a permit for a new $10,000 power house.

Jacques Wolf & Co., Clifton, N. J., manufacturing chemicals, will erect an addition to its plant and also increase its power plant.

The Metzger Motor Car Company, Detroit, Mich., recently incorporated with $1,000,000 capital, is having plans drawn for a plant.

Balke & Co., Louisville, Ky., manufacturing iron parts and foundry products, will erect a new plant to cost about $50,000.

Fire destroyed the mill, elevator and electric-light plant of G. M. Davis and the blacksmith shop of Charles Burger, at Clark, Mo.

The Kilpatrick-French Motor Car Company, Clarksville, Ohio, will erect a garage and repair shop at Broadway and South streets.

The F. A. Whitney Carriage Company, Leominster, Mass., has plans for a new factory to replace the one destroyed by fire recently.

The machine shop of the Boston (Mass.) Elevated Railway Company, on Albany street, was destroyed by fire. Loss, about $300,000.

The Eagle Manufacturing Company, Cincinnati, Ohio, building special machinery, has taken out a permit for a new five-story factory.

The General Electric Company will erect a four-story addition to its plant in Newark, N. J., to be used for the manufacture of lamps.

The City Motor Car Company, Houston, Texas, is erecting an automobile garage and factory at Texas and Caroline streets, to cost $15,000.

Fire destroyed the storage-battery building of the Westinghouse Machine Company, at East Pittsburg, causing a loss of about $60,000.

The Board of Contract and Supply, Syracuse, N. Y., has advertised for bids for 650 tons of cast iron pipe, six to twelve inches in diameter.

The New Jersey Zinc Company has broken ground at Hazzard, Penn., for the erection of an addition, which will double the size of its present plant.

The plant of the Ridgway Refrigerator Manufacturing Company, Kensington, Philadelphia, Penn., was burned, causing a loss of about $10,000.

Fire destroyed the plant of the Traders Compress, at Hobart, Okla., causing a loss of about $300,000. Headquarters are at Fort Worth, Texas.

The Vanderstucken-Ewing Construction Company, Bethlehem, Penn., will erect a fabricating plant. Shears, punches, drill presses, etc., will be needed.

The Pentucket Worsted Mills, Haverhill, Mass., is making extensive additions to its mill and power plant. Expect to add a new engine within a year.

The Marseilles (Ill.) Manufacturing Company will move to East Moline. The company, which is an auxiliary of Deere & Co., manufactures corn shellers and other agricultural implements.

The Maryland & Pennsylvania Terminal Railway Company has awarded contract for the construction of a new roundhouse and shop to cost $25,000.

Halgreen & Co., Heintzehof, Hamburg 1, Germany, importers of hardware, would like catalogs and quotations on steel belt and sprocket chains, machine tools, pipe tools, corrugated roofing material.

The Baker Machinery Company, Des Moines, Iowa, will erect a new and larger plant. Products include elevators, power transmission equipment and machinery.

The Atwood-Castle Company, of Amesbury, Mass., has reorganized as the Castle Lamp Company and will move to Toledo, Ohio, where a new plant will be erected.

The Metropolitan Street Railway Company, Kansas City, Mo., has secured a permit for the erection of a two-story addition to its power plant at Fifteenth and Walnut streets.

The United States Cast Iron Pipe and

Foundry Company, Superior, Wis., is planning to increase the capacity of its plant. Machinery for making water pipe will be installed.

The Simpson Manufacturing Company, Columbus, Ohio, has reorganized and will install additional machinery. The company manufactures machinery and molds for making cement articles.

The West Pulverizing Machine Company is being incorporated at Asheville, N. C., to manufacture pulverizing machine, invented by A. Lincoln West. Foundry, steel-plate house, etc., will be erected.

The Garvin Machine Company, Spring and Varick streets, New York, is installing a library and would be glad to receive catalogs from manufacturers. These should be marked "Library Department."

The Barndt & Johnson Auto Supply Company, Columbus, Ohio, has incorporated and will erect a new and larger plant to replace the present one. The company manufactures automobile bodies and accessories.

J. T. Heffernan, president of the Heffernan Dry Dock Company and the Heffernan Engine Works, Seattle, Wash., has purchased site on which a large ship repair plant will be erected. About 1200 men will be employed.

The Philadelphia (Penn.) Warehousing and Cold Storage Company, which is now building a large addition, contemplates the erection of another. The one now going up will cost about $400,000, and the second one $200,000.

Bids will be received until 3 p.m., April 7, at the office of the Supervising Architect, Treasury Department, Washington, D. C., for installation of ash hoist in extension to the United States postoffice and court house, at Baltimore.

The Finwin Cotton Mill, North Wilkesboro, N. C., plans the construction of a 3000-spindle cotton-yarn mill to cost $70,000. Company was recently incorporated by T. B. Finley, North Wilkesboro, and J. Locke Erwin, Concord, N. C.

Sessel & Rose, Post Office Box 308, Bulawayo, South Africa, importers of mining machinery, etc., wish to extend relations with American manufacturers of mining machinery, mining supplies, hand power wood- and metal-working tools.

The Griffin Wheel Company, with plants in Boston, Chicago, Kansas City, Detroit, etc., has purchased site in Salt Lake City on which a large plant will be erected. This is to cost several millions. The company's plant at Denver, Colo., recently burned.

The Ohio Metallic Specialty Company, Columbus, Ohio, recently incorporated, has purchased site on Bell street, near Broad and will establish a plant for the manufacture of sheet- metal goods, including office furniture, grate fronts, mantels, doors, etc.

Heinrich Scheel, Aokimachi No. 373, Yokohama, Japan, would like to hear from manufacturers, not yet represented in Japan, of the following: Metal and woodworking machinery, printing machinery, forges, steam pumps taps, dies, twist drills, emery wheels, hack-saw blades and frames, steam gages.

Khetter Mohun Dey & Co., P. O. Box 277, Calcutta, Ind., promoters, contractors and managers of light railways, would like quotations on railway equipment, 3-foot 6-inch gage, including 30-pound steel rails with fish plates, dog spikes, bolts and nuts, passenger cars, locomotives, inspection trolleys.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open the following bids: March 29—Trolley hoists (schedule 2331); April 12—Wire rope pneumatic hoists (schedule 2332); oxygen-acetylene welding and cutting plant (schedule 2329), cast-iron castings (schedule 2328).

The Isthmian Canal Commission, Washington, D. C., will receive bids up to 10:30 a.m., April 5, for gasolene launches, boiler-feed pumps, steel, boiler tubes, chain, bolts, rivets, screws, copper, zinc, lead, lead pipe, twist drills, taps, dies, pipe cutters, tube expanders, pulleys, valves, vacuum gages, etc., as per Circular No. 567.

Robert Grimshaw, Dresden A 16, Germany, would like quotations on drill press, to drill 1-inch diameter with tapping attachment; also attachment for high-speed drilling and for running two drills about 4 inches apart, turret attachment for lathe, plain straight grinding machine, portable gas-fired tilting furnace for bronze.

The city of Detroit, Mich., has begun the erection of a water-works pumping station, which will contain boilers of about 3000 horsepower, six 30,000,000-gallon pumping engines, air compressors, electric generator, 30-ton electric crane, coal-handling equipment, etc. Geo. H. Fenkel, civil engineer, will superintend the erection and installation of equipment.

NEW INCORPORATIONS

Modern Auto-Appliance Company, Chatham, N. Y. Capital, $12,000. Incorporators, Frank B. Pratt, W. H. Housman, H. A. Branion.

Chicago Iron Foundry, Chicago, Ill. Foundry and iron manufacturing business. Incorporators, W. W. Scannell, Lawrence Walsh, etc.

E. C. Rassell Manufacturing Company, Toledo, Ohio. Manufacture automobile parts. Capital, $25,000. Incorporators, E. C. Rassell, etc.

Dominion Safe and Vault Company, Montreal, Canada. Capital, $525,000. Directors, H. J. Fuller, Wm. McMaster, Thornton Davidson, etc.

Haines Company, Chicago, Ill. Sheet-metal manufacturing. Capital, $12,000. Incorporators, Wm. B. Moore, R. J. Ross, E. D. Markham.

Ottawa, Montreal & Eastern Railway Company, Montreal. Capital, $2,000,000. Directors, W. J. Bishop, Victor Arsson, Arthur Jarvis, etc.

Eastern Canada Steel and Iron Company, Quebec. Capital, $200,000. Incorporators, Chas. Donoghue, Ernest Duverger, L. H. Gaudry, etc.

The Double-Fabric Tire Company, Auburn, Ind. Manufacture auto parts. Capital, $10,000. Directors, W. H. Willinar, A. L. Murray, etc.

Minerva Hardware Manufacturing Company, Minerva, Ohio. Capital, $20,000. Incorporators, W. R. Kurtz, E. D. Shaw, J. A. Grunder, etc.

Imperial Clock Company, Granite City, Ill. Manufacture time pieces. Capital, $75,000. Incorporators, F. H. Fernand, J. R. Trott, J. Stels.

National Paper and Bag Company, Montreal, Canada. Capital, $200,000. Directors, Wm. Anderson, J. F. Booth, W. H. Dwyer, Ottawa, etc.

Automobile Horn Company, Brooklyn, N. Y. Manufacture automobile horns, lamps, etc. Capital, $100,000. Incorporators, J. T. Allan, G. Dittmann, L. Raunheim.

Bolton Lumber Company, Chicago, Ill. Manufacture and deal in lumber. Capital, $10,000. Incorporators, Edwin R. Moore, C. H. Zillman, J. S. Rybicki.

Wright Piano Company, Jersey City, N. J. Manufacture pianos, automatic player pianos, etc. Capital, $25,000. Incorporators, Wm. A. Reidy, C. W. Wright, Lewis Max.

American High Speed Press Company, New York. Build and repair printing presses, etc. Capital, $300,000. Incorporators, H. Amerman, F. W. Marshall, E. Morrison.

McCormick-Romme Company, Chicago, Ill. Manufacture and deal in machinery, vehicles, etc. Capital, $10,000. Incorporators, Chas. O. Rundall, L. L. Falk, W. J. Dixon.

The L. H. Overly Manufacturing Company, Edgewater, N. J. Manufacture press-metal specialties. Capital, $25,000. Incorporators, E. J. Forham, J. J. Harper, C. F. Martin.

Meier-Andres Belting Company, Newark, N. J. Manufacture leather belting, belt dressing, etc. Capital, $50,000. Incorporators, W. S. Andres, F. P. Meier, C. F. Starzmann.

Electric Piano Operating Company, Binghamton, N. Y. Manufacture pianos, organs, etc. Capital, $100,000. Incorporators, D. F. Simpson, Alonzo Roberson, Louis H. Harris, etc.

Clarksburg Manufacturing Company, Clarksburg, W. Va. Manufacture door plates and novelties. Capital, $10,000. Incorporators, Emery McClung, Lloyd Crane, John B. Payne, etc.

Mutual Lightning Rod Company, Des Moines, Ia. Manufacture lightning rods. Capital, $10,000. Incorporators, W. J. Schoonover, Ruben Viggers, H. W. Parker, F. R. McWilliams

Wood Multiple Typewriter Company, Niagara Falls, N. Y. Manufacture typewriters, duplicating machines, etc. Capital, $50,000. Incorporators, A. W. Gray, C. F. Baumhofer, J. Goffin.

Thomas R. Beggs Faucet and Valve Company, Englewood, N. J. Manufacture faucets and valves. Capital, $200,000. Incorporators, Edward Gruber, Albert Grasing, Henry W. Drury.

Surefoot Horseshoe Company, Jersey City, N. J. Manufacture horseshoes, iron and steel products. Capital, $2,500,000. Incorporators, C. L. Graves, Earl H. Houghtaling, B. C. McPherson.

Coates-Goshen Manufacturing Company, Goshen, N. Y. Manufacture and deal in vehicles, motors, engines, etc. Capital, $150,000. Incorporators, A. R. Coates, J. S. Coates, G. F. Gregg.

Vinot Automobile Company, New York. Manufacture motors, engines, automobiles, etc. Capital, $37,500. Incorporators, H. S. Lake, 27 East Seventy-sixth street; S. Kjeldsen, 1595 Broadway, etc.

Dunn Stoker and Water Gas Furnace Company, Newark, N. J. Manufacture mechanical stokers, water gas furnaces ,etc. Capital, $125,000. Incorporators, Leslie Dunn, Walter M. Thorn, John H. Ryder.

Wm. M. Hoffman Engineering Company, Buffalo, N. Y. Manufacture and sell boilers, engines, dynamos, etc. Capital, $100,000. Incorporators, F. B. Allen, J. Wood, Toronto, Canada, W. M. Hoffman, Buffalo.

The Admiralty Power Company, Port Richmond, N. Y. Manufacture and sell engines, motors, motor boats and vehicles. Capital, $80,000. Incorporators, C. L. Straub, Plainfield, N. J. J. H. Davidson, W. New Brighton, etc.

Ekvall Manufacturing Company, Bronx, N. Y. Manufacture and deal in hardware, etc. Capital, $10,000. Incorporators, Peter Ekvall, 452 East One Hundred and Forty-sixth street, C. E. Anderson, 461 East One Hundred Forty-fifth street, New York.

BUSINESS ITEMS

On March 2 the new and modern plant of the Frank Mossberg Company, Attleboro, Mass., was formally dedicated by a public reception in that place.

The Keller Manufacturing Company, of Philadelphia, has purchased the business of the W. P. Pressinger Company, of New York, its general eastern distributor and distributor for Michigan, and this territory will hereafter be handled direct by the Keller Manufacturing Company. J. J. Swan, secretary of the W. P. Pressinger Company, will be associated with the Keller Manufacturing Company.

TRADE CATALOGS

Westmacott Gas Furnace Company, Providence, R. I. Catalog of gas furnaces. Illustrated, 48 pages, 6x9 inches, paper.

Winter Brothers Company, Wrentham, Mass. Catalog of taps, dies and die stocks. Illustrated, 64 pages, 5x7 inches, paper.

National Bolt and Nut Company, Pittsburg, Penn. Catalog of nuts, bolts, washers, etc. Illustrated, 76 pages, 6x9 inches, paper.

W. S. Rockwell Company, 50 Church street, New York. Catalog No. 8, forge-shop furnaces. Illustrated, 14 pages, 6x9 inches, paper.

Modern Systems Correspondence Schools, Boston, Mass. Catalog of courses in engineering, manufacturing and commercial subjects.

La Pointe Machine Tool Company, Hudson, Mass. Catalog describing broaching machine and broaching tools. Illustrated, 36 pages, 6x9 inches, paper.

Vanadium Sales Company of America, Frick building, Pittsburg, Penn. Catalogs treating of vanadium steels in German and French. Illustrated, 80 pages, 4x7 inches.

Millers Falls Company, Millers Falls, Mass. Catalog No. 31 describing vises, screw drivers, breast drills, grindstones, hacksaw blades and frames, hacksaw machines, etc. Illustrated, 102 pages, 6x9 inches, paper.

FORTHCOMING MEETINGS

Southern Supply and Machinery Dealers' Association and American Supply and Machinery Manufacturers' Association, joint convention, Jacksonville, Fla., April 5, 6 and 7, 1910, Hotel Seminole. F. D. Mitchell, secretary, 309 Broadway, New York City.

National Metal Trades Association, annual convention, Hotel Astor, New York City, April 13-14, 1910. Robert Wuest, Commissioner, New England building, Cleveland, Ohio.

International Railway General Foremen's Association, annual convention, May 3-7, Grand hotel, Cincinnati, Ohio. L. H. Bryan, secretary, Two Harbors, Minn.

National Machine Tool Builders' Association, spring convention, May 24-25, Rochester, N. Y. P. E. Montanus, Springfield, Ohio, secretary.

American Society of Mechanical Engineers, spring meetings, Atlantic City, N. J., May 31-June 3. Calvin W. Rice secretary, 29 West Thirty-ninth street, New York City.

American Foundrymen's Association and American Brass Founders Association; joint convention June 7-8-9, Detroit, Mich.; headquarters, Hotel Pontchartrain. Richard Moldenke, secretary, Watchung, N. J.

National Gas and Gasolene Engine Trades Association. Semi-annual convention, Cincinnati, Ohio, June 13-16, 1910; headquarters, Hotel Sinton. Albert Stritmatter, secretary, Cincinnati, Ohio.

Master Car Builders Association; annual meeting June 15-17, Atlantic City, N. J. J. W. Taylor secretary, Old Colony building, Chicago, Ill.

American Railway Master Mechanics Association, June 20-22, Atlantic City, N. J. J. W. Taylor, secretary, Old Colony building, Chicago, Ill.

Joint meeting of American Society of Mechanical Engineers and Institution of Mechanical Engineers, Birmingham, England, July 26-29, 1910.

American Society of Mechanical Engineers; monthly meeting second Tuesday. Calvin W. Rice, secretary, 29 West Thirty-ninth street, New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's hotel. D. F. P. Clark, secretary, 309 Milk street, Boston, Mass.

Providence Association of Mechanical Engineers. Monthly meeting fourth Tuesday each month. E. C. Bliss, president, 91 Sabine street, Providence, R. I.

New England Foundrymen's Association; regular meeting second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania; monthly meeting third Tuesday. Elmer K. Hiles, secretary, Fulton building, Pittsburg, Penn.

Superintendents' and Foremen's Club of Cleveland; monthly meeting third Saturday. Phil. Frankel, secretary, 310 New England building, Cleveland, O.

Western Society of Engineers, Chicago, Ill. Regular meeting first Wednesday evening of each month, excepting July and August. Secretary, J. H. Warder, 1735 Monadnock block, Chicago, Ill.

WANT ADVERTISEMENTS

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendations or other papers of value should not be inclosed to unknown correspondents. Only bona-fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Caliper catalog free. E.G. Smith, Columbia, Pa.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Special machinery accurately built. Screw machine or turret lathe work solicited. Robert J. Emory & Co., Newark, N. J.

Patented specialty wanted in line of heavy machinery. Schaeffer Machine Works, 35th & Gray's Ferry Road, Philadelphia, Pa.

Light and medium weight machinery and duplicate parts built to order; tools, jigs, etc. MacCordy Mfg. Co., Amsterdam, N. Y.

Wanted—Second-hand steam engine and boiler, 150-200 h.p.; must be first-class condition; give full particulars. Box 339, AM. M.

Patent novelties, dies and experimental work made by Louis L. Loeb, southwest corner Park Ave. & 131st Ct., New York. Correspondence solicited.

Wanted—Machine work for lathes, shapers, milling machines, screw machines, etc., and would be pleased to figure on your dies, jigs, models, sheet metal stampings and auto parts. The F. G. Marbach Co., Medina, Ohio.

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMERICAN MACHINIST.

Dies and press tools for sheet-metal formation designed and constructed in a modern shop, under personal supervision of the best die man in this country. For dies, presses and anything in sheet-metal formation write to Joseph V. Woodworth, Mgr. Harwood Mfg. Co., 42 South 8th Street, Brooklyn, N. Y.

We wish to buy a second-hand slow-speed engine of about 3000 horsepower and about 75 revolutions; we prefer a vertical engine, but will consider a horizontal; also our preference would be to have one capable of carrying reasonable overload; we want the privilege of examination. Please write, stating price, to Pittsburgh Plate Glass Company, Advertising Department, Frick building, Pittsburg, Penn.

Will lease to responsible party, 75 to 100 ton, strictly modern foundry, fully equipped with the very best crane and general foundry equipment; located Allentown, Penn. This foundry adjoining modern machine shop where machining of castings can be arranged for at reasonable prices. The owners will supply foundry with a large amount of work on competitive prices. Address all communications, B. W. Traylor, 30 Church St., New York City.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CANADA

Wanted—A few agencies for Canada or the Province of Quebec by a salesman fifteen years' experience in pumps, boilers, engines and machinery; would confine himself to one line. Box 346, AMERICAN MACHINIST.

CALIFORNIA

Wanted—First-class man, well experienced in manufacturing pneumatic tools; good chance for the right man. Box 314, AM. MA.

CONNECTICUT

Wanted—Diemakers. Apply to Robert N. Bassett Co., Derby, Conn.

DELAWARE

Wanted—All-around machinists for small fine work; steady employment to first-class men. Modern Machinery Co., Wilmington, Del.

Wanted—Draftsman experienced on tools, jigs and fixtures for interchangeable manufacture; preferably a man trained in the manufacture of fire arms; give age, experience and salary expected. Standard Arms Company, Wilmington, Del.

INDIANA

Wanted—Machinists, we are continually increasing our force; we invite applications from lathe and floor hands, those who desire a steady position. Apply at Wood Turret Machine Co., Brazil, Ind.

MASSACHUSETTS

An estimator experienced on small machinery parts, gear cutting preferred. Boston Gear Works, Norfolk Downs, Mass.

Mechanical draftsmen wanted; several thoroughly experienced mechanical draftsmen, including tool designers; no novices need apply; steady work if satisfactory; old established manufactory in Boston suburbs. Draftsman, Box 3536, Boston, Mass.

Wanted—An energetic young man, technical education preferred, to introduce a special brand of steel for machine tool parts in New England territory; permanent position at good salary; applicant should have good general knowledge of qualities required in various machine tool parts; no application considered except from parties of highest standard of character and ability; all applications treated in strictest confidence. Address with full particulars, P. O. Box 1188, Boston, Mass.

We are increasing our force and invite applications from experienced iron and brass moulders, core makers, chippers, pattern makers, draftsmen, production men, machine tool operators (all kinds), brass finishers, polishers, layout men, bench hands, erectors, etc. Heavy and light engine and pump manufacture; works handy to Boston and best evening schools; no labor trouble and applicants are notified as soon as positions are open; applicants should state age, height, weight and experience in detail. Address Employment Division, Blake & Knowles Steam Pump Works, East Cambridge, Mass.

MICHIGAN

Wanted—Toolmakers, die sinkers, lathe hands, machinists and automatic screw machine operators; A-1 men only. Buick Motor Co., Flint, Mich.

Wanted—Assistant superintendent for automobile factory; must be a hustler and able to show from past record that he can produce results, capable of handling men and have executive ability; age 28 to 35; in answering give references, experience and salary expected. Box 287, AMERICAN MACHINIST.

Wanted—By a concern manufacturing Corliss and slide-valve engines and other machinery, a thoroughly competent machinist, familiar with the efficient operation of large and small machine tools and the design of jigs, special tools, etc., to act as assistant to the foreman in machine shop employing 75 men, for the purpose of instructing employees as to best methods of doing work and to devise tools, jigs, etc., for attaining the most economical production. Write fully, giving experience and salary expected. "Expert," AMERICAN MACHINIST.

MINNESOTA

Wanted—Two first-class diemakers, experienced on typewriter, adding machine and deep drawing dies; everything new; beautiful location and healthful surroundings. Reply with reference. W. H. French, foreman, Dilver Manufacturing Company, St. Paul, Minn.

NEW JERSEY

Wanted—Draftsmen familiar with heavy turret lathe work; give references and salary expected. Box 216, AMERICAN MACHINIST.

Men wanted to become mechanical draftsmen; pay $35 to $75 weekly; complete course at your home 4 months. Box 433, Newark, N. J.

Wanted—Machinists; steady work for good milling, boring, lathe and floor hands; also tool and die makers; call in person if possible; cheap rents and pleasant surroundings. Ferracute Machine Company, Bridgeton, N. J. (40 miles south of Philadelphia).

NEW YORK

Wanted—First-class jig and fixture draftsman. Apply Mergenthaler Linotype Company, 24 Ryerson St., Brooklyn, N. Y.

Wanted—Operator on Bardons & Oliver turret lathe; also operator on Pratt & Whitney turret lathe; state experience and wages expected. Otis Elevator Co., Yonkers, N. Y.

Wanted—Mechanical draftsmen, detailers and tracers; state age, education, experience and salary expected, and furnish references. Address H. H. Franklin Mfg. Co., Syracuse, N. Y.

Wanted—A few draftsmen familiar with design of tools, electrical apparatus and switchboard layouts. Apply General Electric Company, Engineer in Charge, Drafting Dept., Schenectady, N. Y.

Sales representative wanted by well established steam boiler and water-pipe manufacturing company for the Pittsburgh territory; no objection to other non-conflicting lines. Box 332, AMERICAN MACHINIST.

Wanted—First-class case hardener accustomed to heat treatment of automobile parts with Brown & Sharpe furnaces; state experience, reference, age and salary expected. Box 335, AMERICAN MACHINIST.

Wanted—Screw machine foreman, must be aggressive and used to quick set-ups; job consists of Brown & Sharpe and Gridley automatics and 15 to 18 hand machines; position steady, salary liberal. Box 342, AM. MACH.

Machinists Wanted—We are enlarging our factory and invite applications from machinists; lathe, drill press and milling machine men, Jones & Lamson operators and toolmakers; in making application, state fully qualifications and wages wanted. The Kirkham Motor Mfg. Co., Bath, N. Y.

Wanted—First-class toolmakers, experienced on jig, fixture, watch tool and precision work. Apply Mergenthaler Linotype Co., 24 Ryerson St., Brooklyn, N. Y.

Wanted—We are constantly increasing our force and invite applications from the following: Machinists, lathe hands, screw machine hands, grinder hands, milling machine hands, motor assemblers, toolmakers, sheet metal die men; we run a nine-hour shop, have desirable surroundings, and offer steady position to desirable characters. Address Superintendent, Maxwell-Briscoe Motor Co., Tarrytown, N. Y.

A live first-class traveling salesman for New York and eastern territory to sell Allen's tool steels; reliable, resourceful and energetic man with good practical knowledge of and experienced in handling high-grade steels; in sending applications kindly state fully and in detail all your qualifications, your specialties, if you have any, whom you have worked for, as well as whom you are working for now, salary expected, references and any other information which will help us in judging the merits of your application; these details will be held in the strictest confidence; opportunities are limited only by employee's ability. Apply by letter only to, Mr. J. C. Ward, Director, Edgar Allen & Co., Ltd., 282 Pearl St., New York City.

OHIO

Wanted—Floor, planer, lathe and milling machine hands; permanent position, good pay; no labor troubles. Box 337, AMER. MACH.

Wanted—By Cleveland firm, several capable draftsmen, expert in motor-car work; only experienced men need apply; situation permanent to the right men. Address, stating experience, age, qualifications, etc., to Box 341, AMERICAN MACHINIST.

Wanted—First-class man, 35 to 40 years old, as assistant superintendent for factory manufacturing office specialties made of small interchangeable parts; must be a hustler capable of handling help and getting out production; give references, experience and salary expected. Box 336, AMERICAN MACHINIST.

Wanted—First-class machinists, toolmakers die sinkers, lathe, planer, drill press, screw machine, boring and milling machine operators, wood patternmakers, brass molders, polishers, buffers, finishers, spinners, millwrights, hammermen and blacksmiths who are seeking positions or desirous of improving on those which they have, to register their names and addresses with the free Employment Department of the National Metal Trades Association. Address Commissioner's Office, 605 New England Bldg., Cleveland, O.

PENNSYLVANIA

Wanted—Experienced draftsman, capable of designing jigs and fixtures for machine tool work. Address Colburn Machine Tool Co., Franklin, Penn.

Wanted—Diemaker for small pressed-steel stampings; steady work, good pay to right party. McDowell Manufacturing Co., 541 Wood St., Pittsburg, Penn.

Wanted—Reliable, energetic traveling salesman, one familiar with paper mill machinery preferred; state age, experience and salary expected. Box 318, AMERICAN MACHINIST.

Mechanical draftsman: wanted at once one first-class draftsman familiar with the design of steam and centrifugal pumps; give age, experience, education, salary expected, and how soon can start. Box 338, AMER. MACH.

Wanted—Assistant mechanical superintendent; technical graduate; familiar with economical methods of machinery manufacture and foundry work; give qualifications, age, experience, salary expected and references. Box 349, AMERICAN MACHINIST.

Wanted—Working foreman for tool department and repair shop in industrial plant located in western Pennsylvania; up-to date mechanic wanted, one who also understands the making of dies for medium drop-forge work; state age, experience, married or single, and if at present employed. Box 333, AM. MACH.

VERMONT

Wanted—A first-class mechanic, who is an expert on the subject of gear cutting, as demonstrator. The Fellows Gear Shaper Company, Springfield, Vt.

WISCONSIN

Draftsman—Wanted, a draftsman familiar with tool and jig work. Address Fairbanks-Morse Mfg. Co., Beloit, Wis.

We are enlarging our works, and are in need of mechanics, especially toolmakers, lathe hands, boring mill and boring-bar hands, and Jones & Lamson screw machine hands. Fairbanks-Morse Mfg. Co., Beloit, Wis.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Wanted—Situation as general superintendent by a first-class mechanical expert, in brass or iron, hardware or specialty line; well up on modern machine work and finishing, designing of jigs and tools; original labor-saving devices; have good executive ability; age 40; American; would not consider making a change for less than $2000 per year. Box 313, AMERICAN MACHINIST.

ILLINOIS

A successful superintendent of the Otis Elevator Company is seeking change of position. Address Box 230, AMER. MACHINIST.

INDIANA

Foreman toolmaker, jig and fixture designer, experienced in outlining methods and operations in shop, wants to advance in position; go anywhere. Box 340, AMER. MACHINIST.

MASSACHUSETTS

Mechanical draftsman desires change; at present with electrical concern; age 30; go anywhere. Box 348, AMERICAN MACHINIST.

Advertiser, 42, would like position as New England representative; has practical mechanical experience as well as business training; has traveled abroad for leading American firms. Box 51, Fenway, P. O., Boston.

NEW JERSEY

Energetic American, age 27, technical education, 6 years' practical machine shop and drafting room experience, good commercial training, desires position as machine-tool salesman or manufacturer's representative; employed at present; only first class position considered. Address Hustler, Box 351, AM. M.

Superintendent and works manager; high class, hustling, aggressive, systematic and economical specialist in practical methods of highest efficiency; piece work applied where no two jobs come the same as well as multiple and interchangeable parts; only large plants will interest me; East preferred. Box 350, AMERICAN MACHINIST.

Wanted—Position as superintendent or assistant superintendent by an A-1 mechanic who has installed high-speed steel and has held the position of feed and speed boss in well known concerns; have held the position of superintendent and assistant master mechanic and general foreman, desire to connect with well established concern; at present employed. Box 331, AMERICAN MACHINIST.

NEW YORK

Mechanical draftsman wants night or job work; New York city vicinity. Box 345, AMERICAN MACHINIST.

Mechanical draftsman, designer, wants position, engines, pumps and general machinery; best references. Box 344, AMER. MACHINIST.

Experienced foreman, middle aged, modern ideas, now employed; engineering work, dynamos and steam pumps; A-1 hustler; can handle large force with ability. Box 352, AMERICAN MACHINIST.

OHIO

Designer and draftsman desires to change; go anywhere. Box 347, AMER. MACHINIST.

Mechanical engineer, technical graduate; broad practical knowledge of engineering; good systematizer; especially able as a producer; several years' experience in engineering work, having had charge of large engineering departments, desires position with first-class firm as chief engineer, or similar position. Box 315, AMERICAN MACHINIST.

PENNSYLVANIA

Position wanted as assistant manager or superintendent by uptodate mechanic in the manufacture of small sheet metal and wire novelties as buckles, suspender trimmings, corset trimmings, pins, safety pins, hooks and eyes, paper fasteners, also duplicate parts as clock movements, typewriter and adding machines, all kinds of stamped work; only first-class position considered; at present holding position as superintendent. Box 229, AMERICAN MACHINIST.

RHODE ISLAND

Cost clerk, now employed, desires to change; nine years in machine shops and foundries; familiar with shop systems; only position as head of department desired. Box 334, AM. M.

A good executive and designer of modern tools for manufacturing, now bringing out a heavy sewing machine, desires change; parties with promises of superintendent with contracts drawn up so as to avoid living up to it, will require some other bait, as legitimate openings will be considered only. Address Z. Lambert, 835 Atwells Ave., Providence, R. I.

VIRGINIA

Designer, graduated by German technical college, 4 years' shop, 6 years' office experience, thoroughly familiar with shop building, coke handling machinery as well as punches, shears and rolls, desires change; first-class references; age 32; married. Address E. F. B, AMERICAN MACHINIST.

FOR SALE

For Sale—200-horsepower Harris-Corliss engine in perfect condition; the reason for selling mill business discontinued. The Elm City Lumber Co., New Haven, Conn.

For Sale—Vending machine and novelty business, comprising patents and complete manufacturing equipment, dies, presses, screw machine, etc. Box 311, AMER. MACHINIST.

A new and most valuable patented tool for machinists or mechanics; will sell patent cheap; something absolutely new and extremely useful. Box 198, AMER. MACHINIST.

Power and foot punch press, universal milling machine, Cincinnati shaper, lathes, drill press, grinders, power hacksaw, water-wheel governor, sprue cutter, anvils and other machinery; also a 3-men foundry equipment, new 10 months ago; patents and patterns for making plumbers' specialties. Box 27, Hartford, Conn.

For Sale—One Nash gas engine, 20 horsepower, two cylinder, for electric lighting, pumping or power; one Beaman & Smith horizontal boring mill; table 25 inches wide, 36 inches long; will bore 12 inches diameter, 24 inches long, and face 20 inches diameter; one 300 light J. B. Colt Co. acetylene gas apparatus. The above machines are in excellent condition, having been very little used. For further particulars and prices apply to Rider-Ericsson Engine Co., 35 Warren St., New York.

Methods of Holding and Machining Lathe Work

Wide Adaptation of the Turret Machine with Automatic Chuck

By F. A. Stanley

The accompanying halftone engravings illustrate some interesting features of the turret machines with automatic chuck built by Bardons & Oliver, Cleveland, O., and also show a number of important adaptations of these machines to the handling of gear blanks, hubs, flanged shells, threaded pieces and other parts manufactured in quantities.

Automatic Chuck Construction

Figs. 1 and 2 illustrate two forms of automatic chuck showing clearly the operating mechanism. The chuck in Fig. 1 is of the "push-out" type, the one in Fig. 2 is of "draw-back" construction. The method of closing the chuck in each case is obvious and needs no description.

A method of holding a casting on an expanding arbor operated by a taper plug forced outward by the chuck-operating plunger is illustrated in Fig. 3. As there shown, the taper shank of the expanding arbor is threaded at the rear end and screwed into the adapter ring which is also threaded and fitted into the enlarged end of the spindle. Another piece of work handled for the second, or finishing operation, on an expanding arbor is illustrated by Figs. 4 and 5, representing respectively the first and second operations on a malleable iron hub. In the first operation, this hub is held in a 3-jaw chuck while a shallow hole in the outer end is bored out by the inserted-tooth tools shown in the turret, which take roughing and finishing cuts; the third position of the turret bringing a piloted tool into position for turning the outside of the hub. The face of the flange and the outside diameter are machined with tools held in the adjusting block on the cross slide.

The second operation on this hub, which is accomplished with the work held upon the expanding arbor, as shown in Fig. 5, consists in machining the outer end of the bore with the two inserted-tooth tools shown in the turret, turning the diameter for the thread with the piloted tool in the turret, threading the end of the hub with the opening die, squaring off the end and rounding the corner of the flange with the cross slide tools. The machine shown is the No. 7 with hexagonal turret, permitting tools to be held either by the shank or by bolting against the flat turret face.

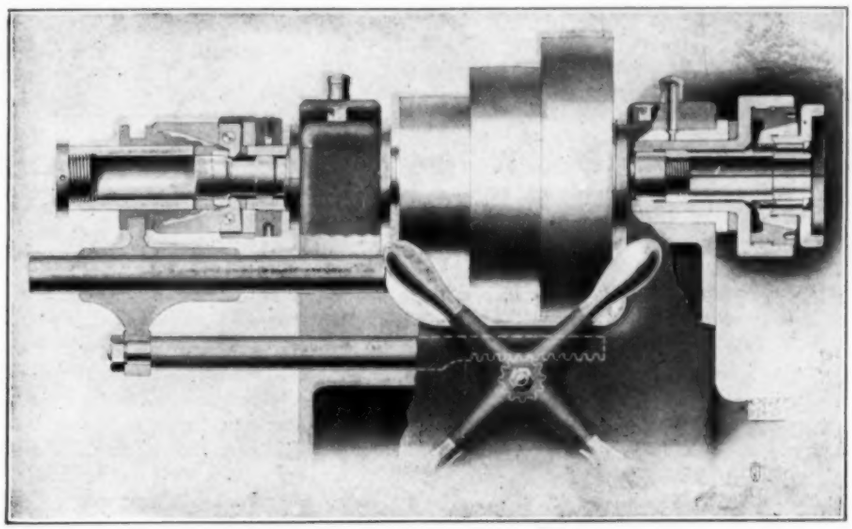


Fig. 2. Draw-back Chuck Mechanism for Bardons & Oliver Turret Lathe

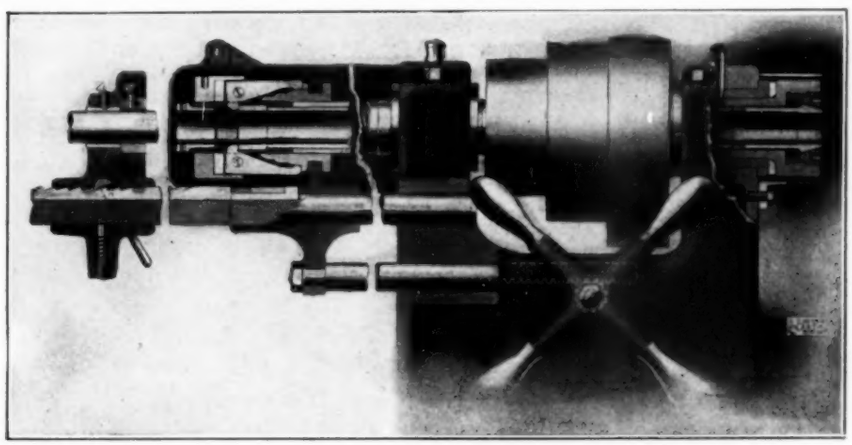


Fig. 1. Automatic Chuck Mechanism for Bardons & Oliver Turret Lathe

Machining Spoked Gear Blanks

Figs. 7, 8 and 9 illustrate a special chuck operated upon the "push-out" principle, and used for holding gear blanks while machining with the turret and cross-slide tools. The construction of the chuck is shown clearly in Fig. 6 and as will be observed upon examination of that illustration in conjunction with Figs. 7 and 8, the chuck is provided with five jaws which are pivoted at the rear end and swung outwardly against the inside of the work rim when the taper plunger is pressed forward. As the chuck jaws grip the rim of the blank internally, the periphery when machined is of even thickness, leaving a neat-appearing blank. The work is shown in place in Fig. 7 and the drill, counterbore and facing tool, the reamer and the piloted turning tool for the outside diameter, are all plainly seen in position in the round turret. The blank is faced back and front to the required thickness by roughing and finishing tools arranged in pairs in the blocks at front and rear of the cross slide. The work as it appears upon being removed from the chuck is shown in Fig. 8, which also illustrates the method of holding the straddle-facing tools at the back, bottom side up, thus making it unnecessary to reverse the spindle during the cutting operations.

Some Operations on the Draw-back Principle

In Fig. 6 is illustrated a method of

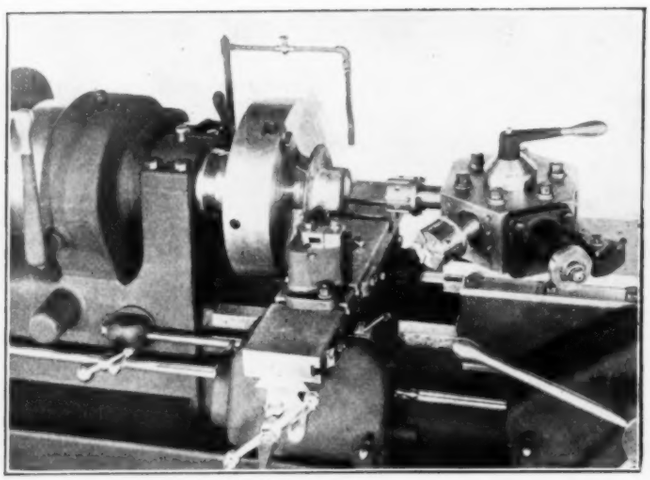


FIG. 4 FIRST AND SECOND OPERATIONS ON A MALLEABLE-IRON HUB

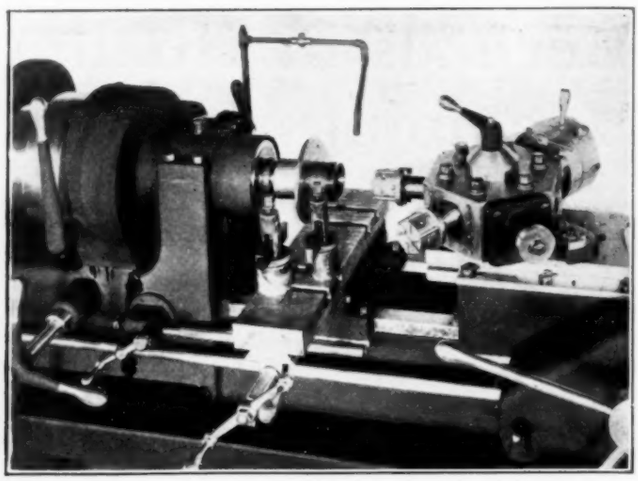


FIG. 5

holding a flanged sleeve upon a split shell which is expanded to grip the work internally by being drawn back over the tapered end and conical shoulder of a hollow plug secured in the adapter ring. The other operations accomplished with the work secured by draw-back attachments are shown in Figs. 10 and 11. In the first of these views a drop-forged gear blank is shown in place upon an arbor where it is held back against a hardened supporting ring by a 3-pronged spider which is backed up by a key in the slot through the end of the arbor. When the work is put in place the draw-back rod is advanced to its forward position allowing the clamping spider and the key to be dropped freely into place in the slot in the arbor. When the pilot wheel is turned to operate the chuck the arbor and clamping device are drawn back tight, forcing the forging hard against the bearing at the rear.

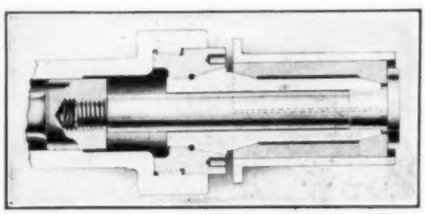


FIG. 6. HOLDING A FLANGED SLEEVE

The outside of the blank is now turned by tools carried in the holder attached to the turret, this tool holder being given additional support by the slotted guide upon the cross slide which receives a tongue under the tool holder. In Fig. 11 the turned blank is shown secured in an extra capacity draw-back collet arranged as indicated in Fig. 2. Here the bore is machined by boring bar and reamer and

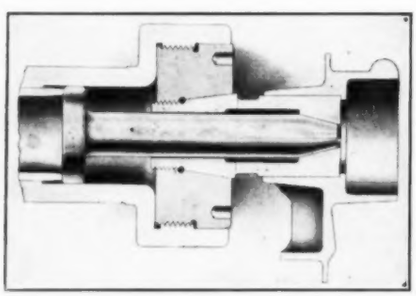


FIG. 3. A CASTING HELD ON AN EXPANDING ARBOR

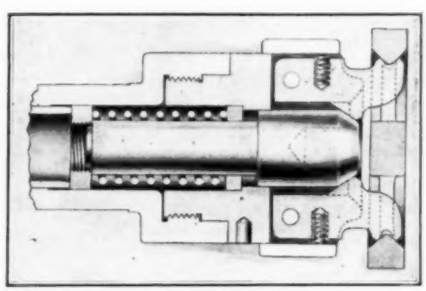


FIG. 9. HOLDING A BLANK BY THE INSIDE OF THE RIM

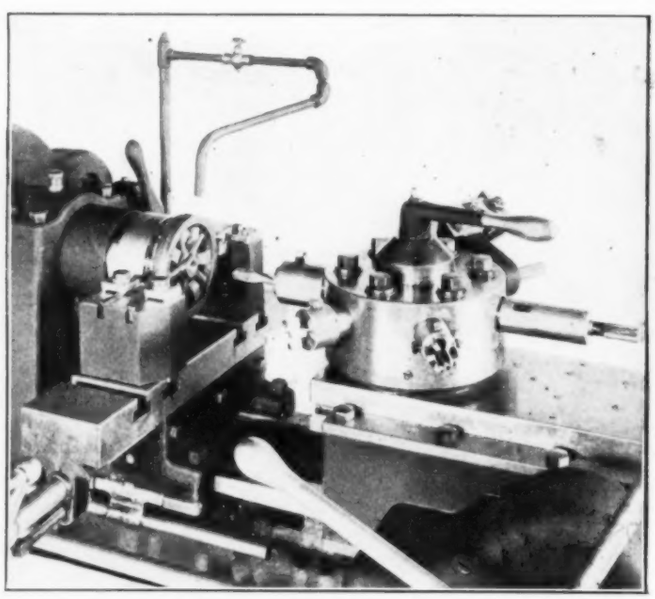


FIG. 7. THE WORK ON THE CHUCK

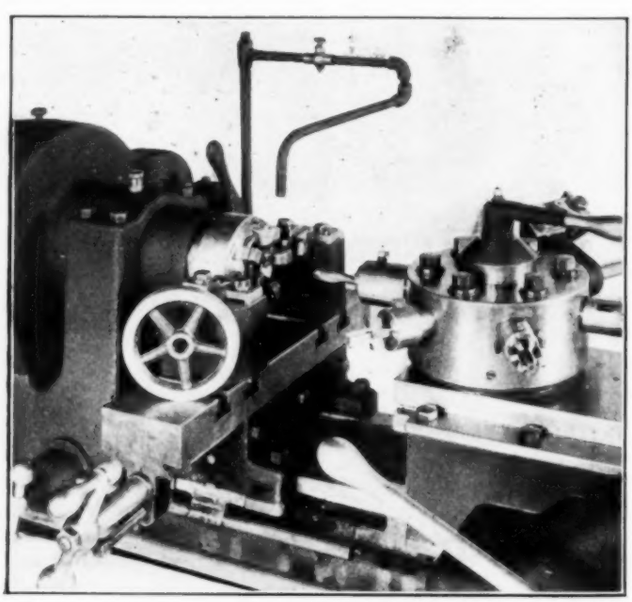


FIG. 8. THE WORK REMOVED

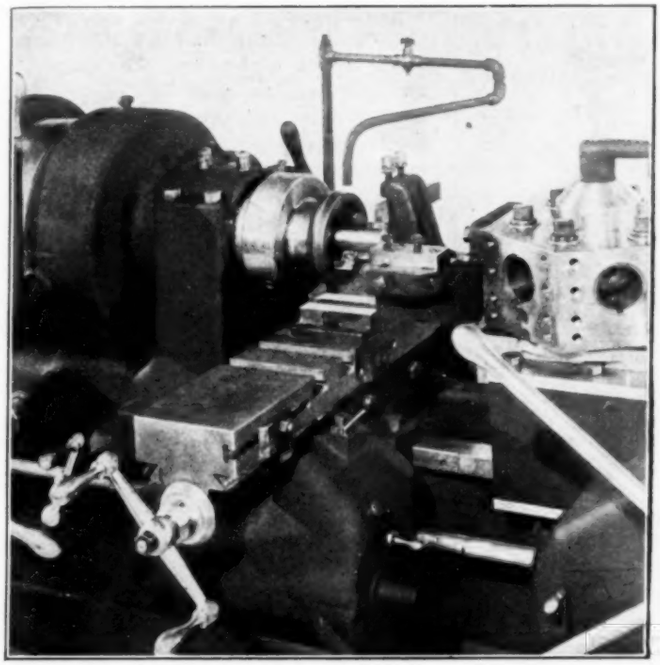


FIG. 10 MACHINING A DROP-FORGED GEAR BLANK

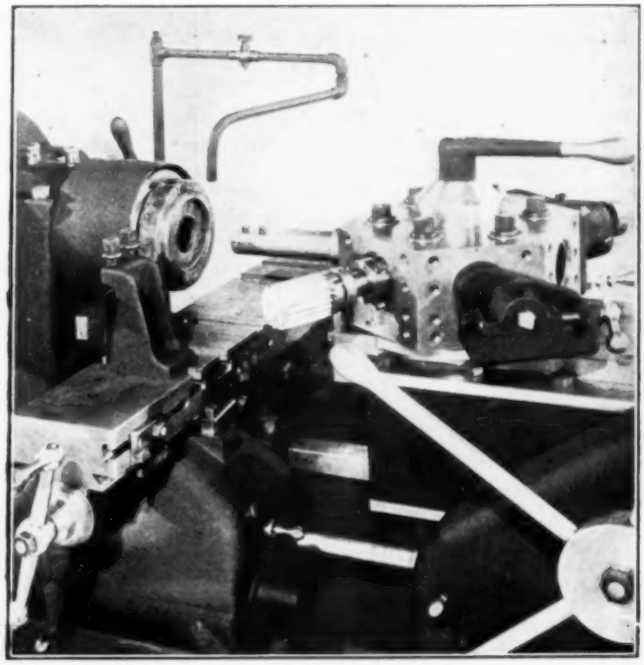


FIG. 11

the surface at the bottom of the recess is finished by the facing tool carried in the third hole of the turret. The diameter of the recess is accurately machined by means of the piloted tool in the turret, and the face from the periphery to the recess is finished with the tool in the post on the cross slide.

HOLDING THREADED WORK

Fig. 12 illustrates a method of holding threaded pieces, the work to the left being a shell with an external thread at the rear screwed into an adapter ring, while the piece shown to the right is threaded internally and fitted on the projecting nose of the adapter. In each case the work is secured by a plug which takes the place of the usual collet and which is moved forward by the chuck mechanism. After the work is finished the pressure of the plunger is removed by releasing the mechanism and the work can then be readily unscrewed from the adapter.

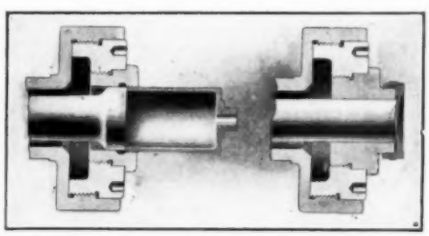


FIG. 12. HOLDING THREADED WORK

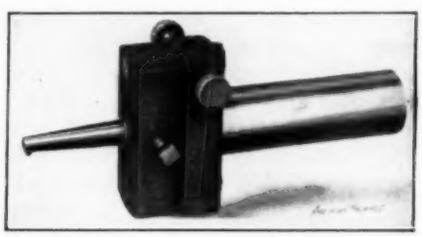


FIG. 13. ADJUSTABLE BORING TOOL FOR THE TURRET

SOME TURRET AND CROSS SLIDE TOOLS

Some interesting turret and cross-slide tools are illustrated by Figs. 13 to 16 inclusive. The first of these is an adjustable boring tool for the turret, which consists of a pivoted tool holder adjusted upon the head by means of two nurled screws. When set properly it is securely clamped by a nut at the back. The tool in Fig. 14 is an adjustable turning appliance provided with a pilot as shown to secure rigidity and hold the tool in proper alinement with the work. The hole for the pilot is tapered and it is a simple matter to make interchangeable pilots of any desired diameter.

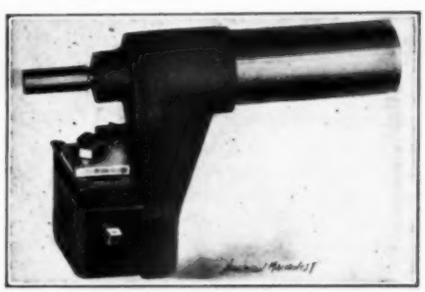


FIG. 14. ADJUSTABLE TURNING TOOL WITH PILOT

In Fig. 15 a cross-slide tool holder is illustrated, which has a tool carrier pivoted at the front to the base and adapted to be rocked, to swing the tools clear of the work, by means of the crank handle at the right. In using this tool on the face of a piece, where a hub, say, and a flange projecting to different hights from the face of the work are to be machined, the tool is fed across the face of the hub by feeding the cross slide forward, and the two cutters which have taken, respectively, roughing and finishing chips, are then swung clear of the projecting rim or flange on the work by turning the crank handle to the right against the opposite side of the stop pin shown projecting above the upper surface of the tool holder. These facing tools being cleared in this way from the edge of the work, permit a tool carried in the post at the rear end of the cross slide to be advanced for the squaring off of the projecting rim.

Fig. 16 illustrates a type of round tool post which is provided with a large base

FIG. 15. FACING TOOL WITH ROCKER FOR CLEARANCE

and an extra clamping bolt, so that the holder is secured in two slots of the cross slide and is thus held rigidly. The opening for the clamping screw in the base projection is sufficiently large to provide ample adjustment for the base, and the tool post proper may be adjusted to any hight or turned to any position necessary as in the case of the plain, round post.

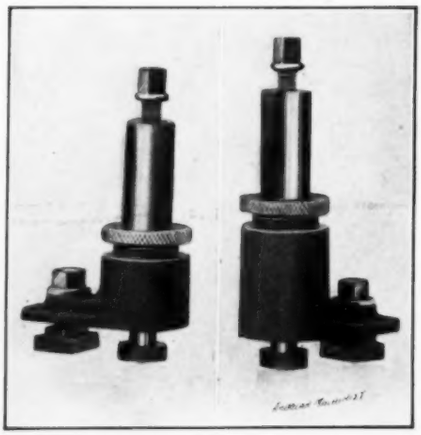


FIG. 16. ROUND TOOL POSTS WITH FLANGED BASE

POWER-FEED MECHANISM

The feed mechanism, giving six rates of turret feed, as now applied to this make of turret lathe, is shown in Fig. 17. The drive for the gear box is taken from the shaft shown near the bottom of the box and through gears drives the worm shaft and worm wheel on the pinion shaft. The feed changes are secured by manipulating the handles in front of the case.

A similar arrangement of gearing for the cross slide is shown in Fig. 18. The driving rod in this case actuates the nest of gears, the gear cone in front driving through bevel reversing gears and clutch, a pair of spur gears at the left, which operate the worm shaft and the worm wheel on the feed screw. The gears on the shaft at the front of the box are controlled by a sliding key operated by the handle at the right, while the reversing mechanism is controlled by the handle to the left. Four rates of feed are obtainable in either direction.

The gears in both boxes run in oil. The operating worms are of steel and hardened, and the worm wheels are of phosphor bronze. Automatic knock-offs are provided for both turret and cross-slide feeds, the adjustable trips and the controlling latch for the cross-slide mechanism being plainly shown in Fig. 10.

The drive for the power feed is derived from a train of gears at the head end of the machine. The same feed shaft actuates the cross-slide and turret-feed mechanism, but the feed changes of each are obtained independently.

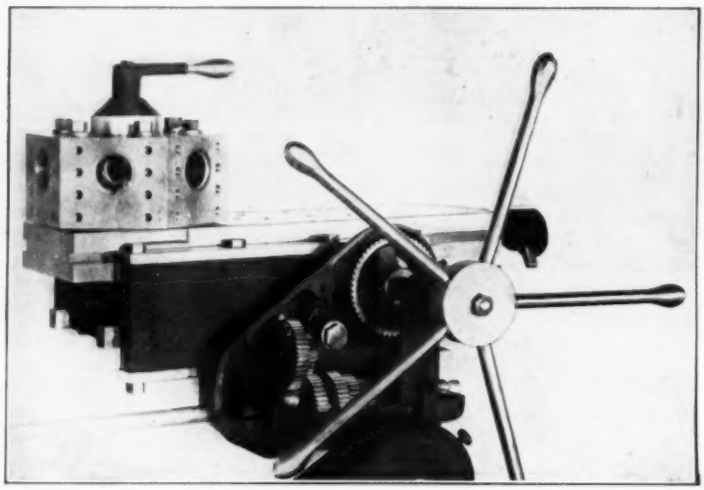


FIG. 17. FEED BOX FOR TURRET SLIDE

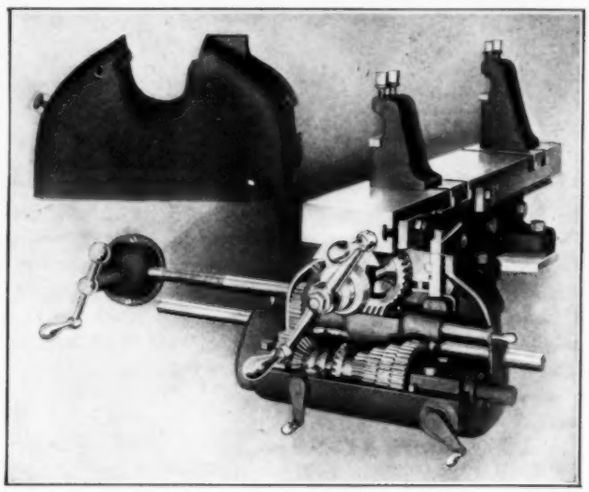


FIG. 18. FEED BOX FOR CROSS SLIDE

Article Writing and Employers

By E. M. Senyour

The increasing popularity of the AMERICAN MACHINIST is mainly due, no doubt, to its interesting contents contributed by practical men, and which accumulate more and more readers, its value as an advertising medium increasing proportionately. From time to time your correspondents have shown how they have benefited through writing to your columns, and as an occasional correspondent, I can attest to benefits received either by the knowledge gained through having to make oneself fully conversant with the subject treated or in a secondary manner through payment for articles, which enables one to buy the necessary books and instruments to obtain further knowledge.

There is another point which I have not seen dealt with to any great extent, and that is the encouragement given by employers in the preparation of articles for publication in engineering papers. The American firms seem to be greatly ahead of English ones in this respect, if details of works and machines given in your columns are anything to go by. The English firms retain their conservatism and are fearfully anxious lest their secrets should be made known. These so-called secrets must not be written about by anyone they employ, although they have been "everybody's secrets" for years. Of course, there are real secrets which a person should not disclose, but many are imaginary ones.

The result is that accounts of workshop practice are withheld and the firm loses the opportunity for a good, inexpensive advertisement. I have suffered in this way, and no doubt many of your contributors have also been handicapped; many an interesting article has never seen print because a few necessary points would come under the ban of the censor and it is not always advisable to risk your position by incurring your employer's displeasure. I write this in the hope that those concerned may be led to change their ideas and may grant better facilities to their employees, thus benefiting themselves through increased publicity and indirectly through bettering their servants' knowledge. The good results of such a policy are not always immediate, but in the long run it pays.

Boring Crank Case and Milling Cams

By F. H. Colvin

The illustration shows one of the most interesting crank-case boring fixtures that we have seen. The fixture itself is very clearly shown in Fig. 1, mounted on the platen of a Lucas horizontal boring machine, with the outer end of the fixture supported on the auxiliary table. carriage moved forward to the required center distance of 6 inches. This brings the boring bar central with the second line of bushings that are used in boring the cam-shaft bearing. The boring bars are ground 0.0015 inch under size and have adjustable cutters which are well ing cutter is mounted on a slide on the lathe carriage and, as can be seen, is driven by a powerful belt.

The slide carrying the milling cutter is controlled by a hardened-steel roller of the same size as the cutter which is acted upon by the master cam

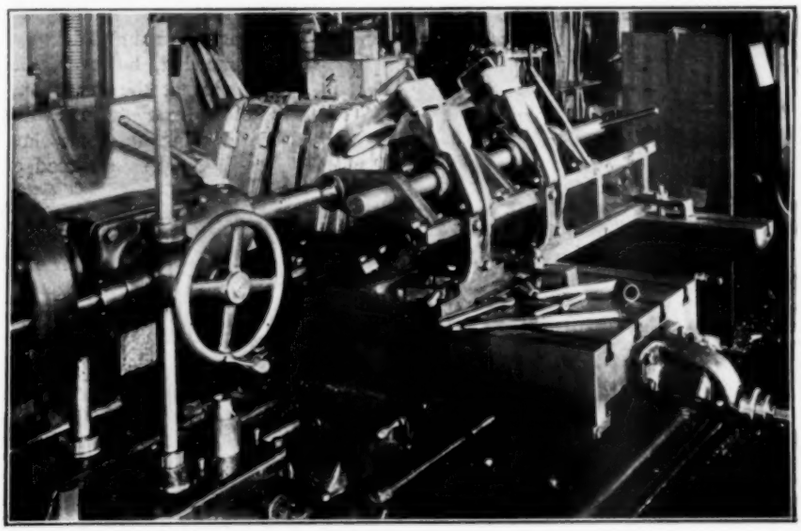


FIG. 1. A NOVEL CRANK-CASE FIXTURE

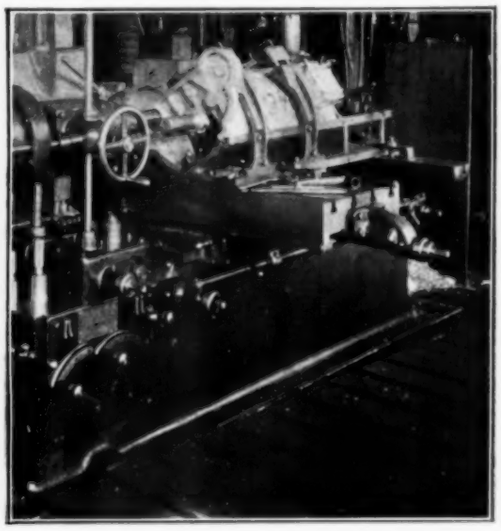


FIG. 2. THE FIXTURE IN USE

This boring fixture carries five arms, one for each bearing in the crank case, and each arm has two bushings with a center distance of 6 inches. The crank cases are located by the overhanging guide, which goes in the cylinder hole in the upper side of the case, being set for the center or crank-shaft bearings first.

The front end of the boring bar is turned down sufficiently to be guided by a slip bushing, which is carried inside the main bushing in the arm behind each bearing as shown by the sketch in Fig. 3. When the first bearing is bored the slip bushing is removed and placed in the arm behind the second bearing. The boring bar is now guided by the slip bushing ahead of the cutter, and the full-sized bushing behind it, which insures steadiness and alinement, and this is repeated until all five bearings are bored and the boring bar fills all bearings and bushings.

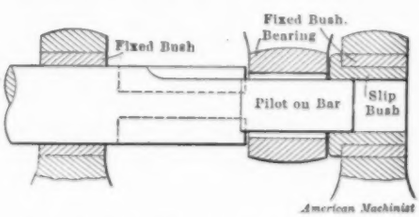


FIG. 3. THE USE OF SLIP BUSHINGS

After a lot of crank cases are bored in this way the locating bar is run through the crank-shaft bearing and the

cared for. This makes it almost impossible for these bearings to be much out of line as they are all controlled by hardened bushings in stationary arms with fixed distances. This is an extremely interesting fixture and gives remarkably good results.

MILLING THE CAM SHAFT

A special machine has been built for milling the cam shaft as can be seen in Fig. 4. These cams are integral, the whole shaft being turned from the bar in a Lo-Swing lathe, and come to the milling machine in the condition shown. This machine is built from an engine and has a worm-driven head, which revolves the stock at the proper speed. The mill-

shaft at the back. This cam shaft is held in very substantial bearings, which are flattened in front to allow the driving roll to pass by in being moved from one cam to the other.

This makes a very simple and effective method of milling the cams; the cam shaft being milled is firmly supported very close to the cut so that exact reproductions of the master cam are readily secured and the result has proved entirely satisfactory. After being heat treated, they are straightened and ground on the regular cam-shaft grinder.

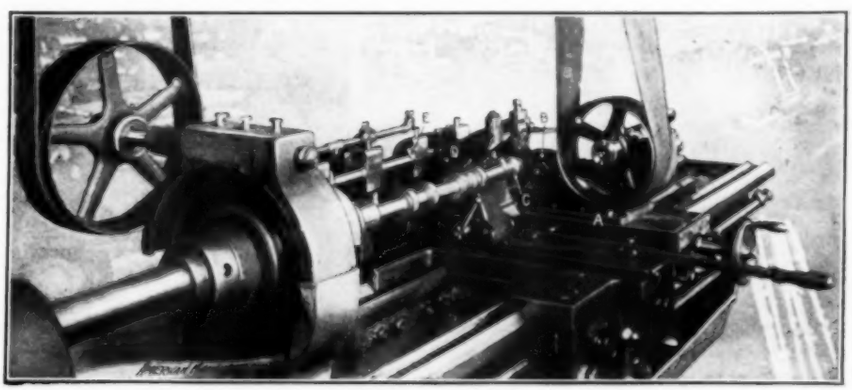


FIG. 4. A SPECIAL CAM-CUTTING MACHINE

We are indebted to W. H. Lonsdale, superintendent of the Knox Automobile Company, Springfield, Mass., for assistance in preparing this description.

Design of Hydraulic Press Cylinders

*By A. Lewis Jenkins**

In every construction cost must be considered, and this frequently dictates the choice between cast iron, steel castings or steel forgings for hydraulic-press cylinders. Cast iron and steel castings prove very satisfactory when the cylinder is packed in the neck with U-leather packing, in which case the bore is only finished from the mouth of the cylinder to a few inches past the packing, the remaining portion of the bore being cored to about one or two inches in diameter larger than the ram. When the packing is placed on the end of the ram the inner surface of the cylinder must be well finished to prevent wear of the packing. For this reason a brass-lined cylinder or a steel cylinder bored and ground gives best results. For machines that stand unused for several weeks at a time, as wine and oiling presses, a copper-lined cylinder fitted with a cup leather packing on the end of the ram is perhaps the best, as the surface over which the packing moves is not liable to be injured by corrosion. The copper lining is close grained and assists in making the cylinder impervious to liquids; but unless perfectly fitted, water will find its way between it and the cylinder, causing leaks or even rupture of the lining.

Factors of Safety

The factor of safety used in the design of cast-iron cylinders should not be less than 4, allowing about 6000 pounds per square inch for the unit working stress. For steel castings a factor of safety of 3 to 4 is often used, which corresponds to a unit working stress of from 13,000 to 18,000 pounds per square inch.

A most important consideration in the design of hydraulic-press cylinders using a high liquid pressure is the density of the material, which is entirely aside from the tensile strength. Cylinders with a factor of safety of from 4 to 6 based on the ultimate strength of the material are often worthless on account of the porosity of the material. Water under a pressure of 3000 to 4000 pounds per square inch will ooze through cylinder walls of open-grained cast iron 3 to 4 inches thick. For these high pressures it is well to use air-furnace iron, which is a very dense material having a tensile strength of from 30,000 to 40,000 pounds per square inch; although steel castings usually prove satisfactory for this purpose.

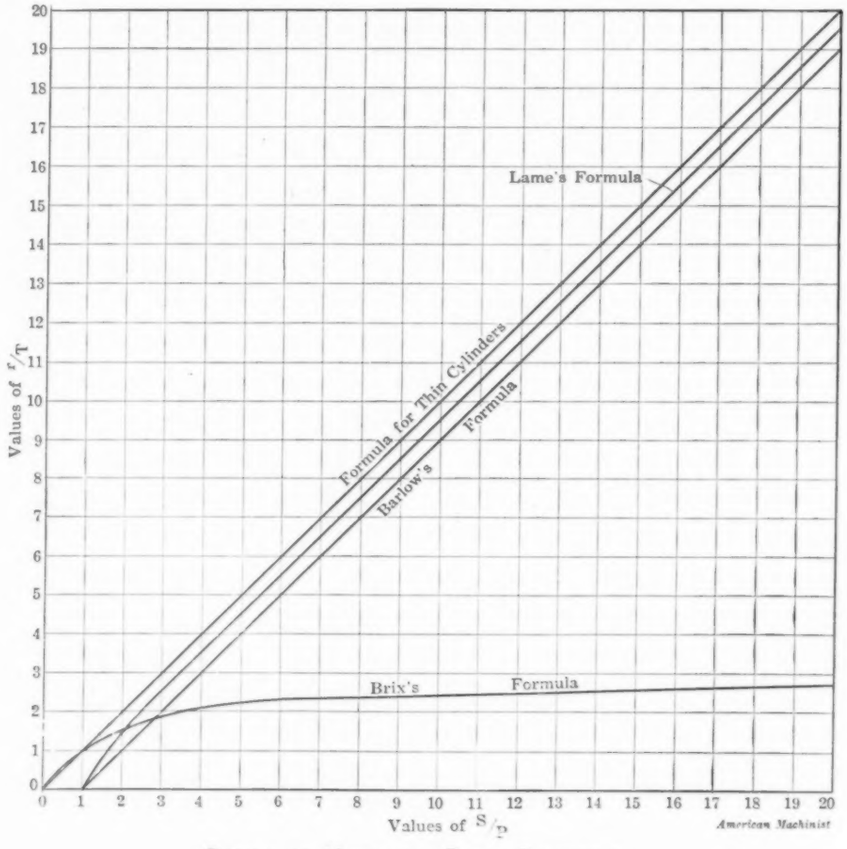
Porous Cylinders

The failure of cylinders to be thoroughly impervious to liquids is frequently the cause of much annoyance and expense in connection with hydraulic-machinery construction. To satisfy a customer wanting a machine at a specified time it is often necessary to pass a cylinder which, when first tested, failed to hold the pressure, the water or oil oozing through the walls quite freely. If the defective cylinder is only porous in spots, it may sometimes be rendered permanently tight by peening the porous spots with sledges. If the trouble is not localized it may sometimes be overcome by pumping starchy water, prepared from potatoes, into the cylinder and holding the pressure at from 500 to 1000 pounds per square inch for an hour or more. This will usually make the cylinder impervious to water but not to oil, as the starch acts chemically with some oils used in hydraulic systems. In 1849, the first cylinders used for raising the Britannia bridge proved porous and leaky, and were made tight by pumping meal gruel and salammoniac into them. Salammoniac may be used by simply filling the cylinder with a strong solution and allowing it to stand for 24 hours; but this method is not recommended, for if the coating formed on the inside of the cylinder should become cracked the trouble would again appear. It is readily seen that if this solution be used under pressure, the pores would become permanently closed. Cylinders have also been successfully sealed by the use of Ferrofix and Thermit.

Formulas for Thick Cylinders

There are several formulas for the design of thick cylinders, none of which seem to express the exact relation between the stress pressure and thickness. It is generally conceded, however, that the stress is greatest at the inner surface and decreases from there to the outer surface according to some law. This was verified with cylinders used on the Britannia bridge. The cast-iron cylinders, 20 inches in diameter and 8¾ inches thick, failed, and were replaced by wrought-iron cylinders 8 inches thick. To the discouragement of the engineers the wrought-iron cylinders expanded when subjected to the high pressure, causing leakage between the ram and cylinder. By the use of larger rams the inner portion was expanded until it had taken a permanent set without any appreciable change in the outer diameter, which showed that the stress was greater at the inner than at the outer portion.

This law of variation for the hoop stress in cylinders subjected to internal



Design of Hydraulic Press Cylinders

*Assistant professor of mechanical engineering, University of Cincinnati.

pressure has been expressed differently by several authorities as follows:

Let

T = Thickness of the cylinder walls in inches,

r = Inside radius of the cylinder in inches,

P = Pressure in pounds per square inch of the liquid,

S = Greatest unit tensile stress in pounds per square inch,

e = Base of the hyperbolic log. system.

On the assumption that the internal diameter is not altered by the pressure of the liquid, Brix deduced the formula

$$T = r e^{\frac{P}{S}} - 1.$$

The most modern conception of the law of variation of stress in a thick cylinder is based on the elastic theory and is expressed by Lame, as

$$T = r\left(\sqrt{\frac{S+P}{S-P}} - 1\right).$$

The formula for thin cylinder assumes that the stress does not vary from the inner to the outer surface; but is equally distributed throughout the annulus and is written,

$$T = \frac{Pr}{S}.$$

Barlow assumed that the sectional area of the annulus does not change and deduced the formula,

$$T = \frac{Pr}{S-P}.$$

To compare the results given by the above formulas, the curves in Fig. 1 have been drawn to show the relation between S/P and r/T. By solving the above equations for S/P in terms of r/T they become as follows:

Brix . . . . . $\frac{S}{P} = \frac{1}{1 - \log_e \frac{r}{T}}$,

Barlow . . . . . $\frac{S}{P} \quad \frac{r}{T} - 1$.

Lame . . . . . $\frac{S}{P} = \frac{\left(1 + \frac{T}{r}\right)^2 + 1}{\left(1 + \frac{T}{r}\right)^2 - 1}$,

For thin cylinder. . . $\frac{S}{P} = \frac{r}{T}$.

It will be noticed that the values given by Lame's formula are between those given by Barlow's and the formula for thin cylinders, whereas Brix's formula gives greater values for the thickness than any other when S/P is greater than 3.

These curves not only offer an excellent method of comparing the results given by the different formulas, but should be useful to designers of thick cylinders. Suppose it is desired to find the thickness of a cast-iron cylinder, 20 inches in diameter, to be subjected to an internal pressure of 1000 pounds per square inch and the working stress of the material to be 6000 pounds per square inch. In this case S/P = 6, and r = 10 inches. To determine the thickness according to any formula, say, Barlow's: Trace the vertical line marked 6 until it cuts the curve and note the corresponding value of r/T. In this case $r/T = 5$, and since $r = 10$ inches, $T = 2$ inches. The values for the thickness as given by the other curves are similarly found to be as follows: Brix 4.34 inches, Lame 1.83 inches, thin cylinder 1.66.

This variation in results has attracted the attention of many engineers and mathematicians who have endeavored to verify some of these formulas by experiment, among whom is Professor Goodman, of Leeds, Eng. He, by the use of a delicate extensometer, placed at different depths in radially drilled holes, was able to determine the stresses at these depths. As a result of this investigation he found the stresses almost coincided with the values given by Barlow's formula. Hence, notwithstanding the fact that Lame's formula is based on the modern theory applied to stresses and strains in elastic bodies, Barlow's formula is probably the most accurate statement of the law of variation of stress in the wall of a thick cylinder.

Bottoms of cylinders are often made hemispherical, with the same radius and thickness as the cylinder walls, but some designers prefer to use an inside radius equal to ¾ and a fillet equal to ¼ the diameter of the cylinder, and a thickness equal to that of the cylinder walls.

The thickness of a hollow sphere according to the above theories is as follows:

Brix . . . . . $T = \frac{Pr}{2S}$.

Barlow . . . . $T = \frac{Pr}{2R - P}$.

Lame . . . . . $T = r\left(\sqrt[3]{\frac{S+P}{S-P}} - 1\right)$.

Thin cylinder. . $T = \frac{Pr}{2S}$.

By these formulas the thickness of a sphere is less than the thickness of a cylinder of the same radius, hence, either of the above mentioned proportions should give satisfactory results.

Cylinders should never be designed with flat ends as the initial stresses and the crystallization produced during cooling render them weak.

In designing a hydraulic press for general purposes it is customary to support the cylinder on a steel or wooden sill by means of two flanges, each consisting of a flat plate equal in breadth to the outside diameter of the cylinder and reinforced with ribs. These flanges are considered as cantilever beams, uniformly loaded, each flange taking half the load. Another method frequently adopted for a certain class of presses is to support the machine by a sole plate on the bottom of the cylinder; there being no sills in this case, lugs are cast on the sides of the cylinder to receive the strain rods. These lugs may be considered as cantilever beams at their ends, but in many instances the load is not equally distributed among them because some of the rods may be stressed more than others, due to the unequal density of the material to be squeezed in the press. The unequal density of the material becomes a serious consideration in the design of presses used for baling waste paper, tin cans and like materials; which is due to the fact that it is almost impossible to distribute the material evenly while charging the press. In some cases a small flange or ring is cast entirely around the cylinder and supports it in a hole cast in the sill.

Great care should be exercised in the design of flanges or lugs for cylinders to prevent the castings from being spongy in the neck, which is a most objectionable place if U-leather packing is to be used there. Holes for pipe connections should be strengthened with bosses or the cylinder will be weakened.

When cast, the outside of a cylinder cools more rapidly than the inside and this causes the inner portion to have an initial tensile stress when cold. This stress may be relieved by annealing or obviated by having a pipe placed in the core through which water may be circulated. By cooling the core it is possible to produce an initial compressive stress in the inner portion which will greatly increase the strength of the casting.

The Expense Burden

By A. A. Pratt

I wanted information about the cost of some small tools, and visited the shop of a typical Pennsylvania Dutch machinist. He looked me over and asked if I was going into the business. I explained the situation, saying that I wanted the figures for a friend of mine in New York. To this he replied that he might as well give them to me, for if he didn't, I would get them elsewhere. "You generally get what you go after."

I thanked him.

He gave me the prices and said: "That is what they cost me, but I can't make 'em for that. That is, my books show I don't make so much profit as I would if they only cost me that."

I carefully explained that he probably had no charge for overhead expense, selling expense, etc. It took him a long time to see through it, but finally he grinned and said: "Yah! I see vot dose tools cost iss not vot dey cost, but more. Aind id?"

Just so! The expense burden is ever with us, like the poor.

Replacing Piece by Premium Plan of Paying for Work

The Change Can Be Accomplished by Use of Common Sense

By L. Chamberlain

Much has been written on the premium and kindred systems and time saving in shop operations. I have attempted to follow these articles closely and so far have failed to find anything that promises improvement on the premium system without a more than compensating clerical expense. Much of the matter written has been open to the objection, from the shop man's view, that it was theoretical rather than practical, or was written from the office point of view without considering actual conditions in the shop.

C 189 5M 2-09 B.P.C.

TYPE & SIZE _____ NAME OF PART _____ DRG. NO. B 7483

DATE	EST. MIN.	LOT LIMIT	ALLOWANCE
6-6-06			$2.00
4-25-08	1.30		2.15

OPERATION (Omitted)

DATA (")

TYPE MACH. _____ MACH. NO. _____

TOOL NOS. _____

| | | |

In fixing premium allowances no attention is paid to No. 1. The minimum time in which No. 2 can do a good job is ascertained and 50 per cent. added to this, and this is considered the time allowance on the job.

It is not intended or expected to make a time allowance that will enable No. 4 and No. 5 to make premium. If No. 2 can make 25 per cent., No. 3 should make 15 per cent. and it is assumed that the allowance is fair. If No. 4 and No. 5 cannot make premium, the fault lies with them, and it is optional with the foreman whether to keep or dispose of their services.

Inspection

All premium work, as well as day work, will be carefully inspected by the shop inspectors. This inspection will usually be made shortly after a job is finished, but sometimes may not be made for quite a while, depending upon the work ahead of the inspectors.

Spoiled Work

For all pieces rejected by the inspector or foreman, and scrapped, workman will be charged "time allowance" on that piece. Loss of material and labor of any previous work will be borne by the company.

Where faulty work is discovered before the job is finished, the time necessary to repair it will be charged against the job.

With this explanation I will return to my subject.

The difficulties, mainly psychological, encountered in changing from piece work have deterred many firms from using the premium system, and, while this paper is a recital of facts and the result of practical observation by one who is up against the question every day, it is to be expected that it will be difficult to outline a definite, satisfactory plan, that, adopted by others, will work out satisfactorily. The best I can do will be to outline the system practised by several companies where the change from piece to premium work is still in evolution.

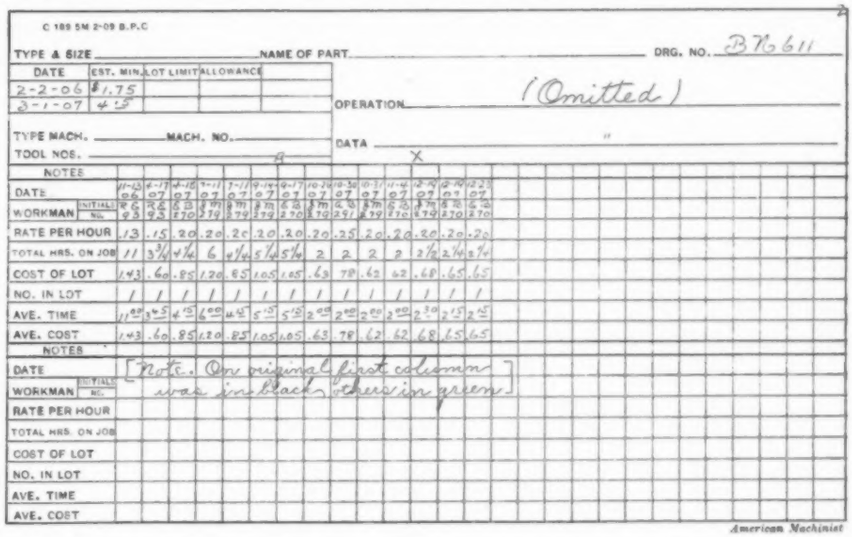
Changing from Piece Work to Premium System

It is to be regretted that we cannot always deal with people frankly and openly, but we cannot, and we must, therefore, deal with human nature as it is, not as we would have it. The reason for a large majority of failures can be traced to the fact that someone laid out their plan of action and expected, or attempted, to force facts to conform to their theory. Facts are notorious for their stubbornness, and to this same class belong the mass of men until they can see definitely and clearly whither they are being led. It is necessary, therefore, to move along the lines of least resistance, compatible with discipline.

Be they just or absurd, the prejudices of the men as a whole must be taken into consideration if we are to apply a remedy or effect a change that concerns them as a body. It is possible to effect *any* reform if only one point is pressed home at a time. The average boy will not fight at the first blow, but says, "Just hit me again," and he may be hit again with safety if one waits long enough for him to cool off. This is not cowardice, but a trait that shows up in a man as conservatism; so, even when changes are really for their benefit it is necessary to use strategy. Sometimes changes of this kind mean a pocket edition of Sherman's characterization of war, but at all times it is a game of chess, and the wise man sacrifices a few pawns, knowing that as his game is good he will ultimately be able to say "checkmate." This, however, must not be taken to mean that the usual brand of what is called diplomacy is used; nor does it mean any compromise short of absolute justice to both sides. But it does mean not to force disagreeable facts into prominence when it is not necessary. I am assuming in this connection, and this assumption is generally correct, that the change from piece to premium plan is being made for the reason that piece prices have reached the place where they are beyond control and are higher than they should be, or that work is being curtailed in order to prevent a cut.

It may appear as though an injustice were being done the employee by changing under these circumstances; but it is not so in any sense of the word. It simply means that justice is being done the employer and matters are being so arranged that a man may increase his earnings with proper industry. One of the most frequent objections urged by the unthinking man is that he objects to giving half his earnings to the company—that he works and makes the saving and they get half the benefit. In instances of this kind I carefully reason out with the man that it makes no difference to him whether the premium is 50 per cent. and he gets 25 per cent. and the company 25 per cent., or whether it is arranged so that the allowance is 25 per cent. and he gets all of it. If a job is so set that it is possible to make more than 25 per cent. added premium, the condition has arrived that brought the piece-work system into disrepute; namely, that the cost has got beyond the limit figured by the employer, and as there was no redress under the piece-work system, the only alternative was to cut. Under the premium system the employer has guaranteed no cut for a year, figuring that if the time was set too high, the fault was partly his and he is willing to stand for half the difference, the other half is what the man pays for his yearly guarantee.

To herald the fact that on a certain day all piece-price allowances will be superseded by premium allowances is to invite resistance from the moment the notice is posted. To avoid this friction


C 189 5M 2-09 B.P.C

TYPE & SIZE _____ NAME OF PART _____ DRG. NO. B76611

DATE	EST. MIN.	LOT LIMIT	ALLOWANCE
2-2-06	$1.75		
3-1-07	4.5		

OPERATION (Omitted)

TYPE MACH. _____ MACH. NO. _____ TOOL NOS. _____ DATA _____

NOTES																								
DATE		11-15 06	4-17 07	4-18 07	5-11 07	7-11 07	9-14 07	9-17 07	10-10 07	10-30 07	11-6 07	12-19 07	12-19 07	12-22 07										
WORKMAN	INITIAL	RC	RC	CS	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM										
	NO.	95	95	270	279	279	279	279	279	279	291	279	270	279										
RATE PER HOUR		.13	.15	.20	.20	.20	.20	.20	.20	.20	.25	.20	.20	.20										
TOTAL HRS. ON JOB		11	3¾	4¼	6	4¼	5¼	5¼	2	2	2	2	2½	2¼										
COST OF LOT		1.43	.60	.85	1.20	.85	1.05	1.05	.63	.78	.62	.62	.68	.65										
NO. IN LOT		1	1	1	1	1	1	1	1	1	1	1	1	1										
AVE. TIME		11:00	3:45	4:15	6:00	4:45	5:15	5:15	2:00	2:00	2:00	2:00	2:30	2:15	2:15									
AVE. COST		1.43	.60	.85	1.20	.85	1.05	1.05	.63	.78	.62	.62	.68	.65	.65									
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DATE																								
WORKMAN	INITIAL																							
	NO.																							
RATE PER HOUR																								
TOTAL HRS. ON JOB																								
COST OF LOT																								
NO. IN LOT																								
AVE. TIME																								
AVE. COST																								

American Machinist

Fig. 2. Specimen Record Showing How Cost Was Reduced and Men Still Making an Excess Premium

and possible conflict requires not diplomacy so much as common sense and honesty and the ability to reason cause and effect. The mechanical change from piece work to premium work is small.

Before starting to change over, it were well to assure ourselves that the average wage of the men affected is equal to that paid elsewhere for a similar class of work. It is the usual practice to set a smaller rate for piece work than for day work, although a good reason for this has yet to appear. The very fact of equalizing wages, which usually means a raise, is pleasing to the men. This being done, the road is clear for a start.

Changes Should Be Made in Busy Times

Changes should preferably be made in busy times, and those prices which are too low should be picked out and changed first, and if it is found necessary to fix the premium on some of these so that the

man figures that he is receiving more than under the piece-work system, so much the better. After the idea has been firmly implanted, and the men assured that no changes will be made for a year at least, one can proceed more boldly and change prices that have been too high, but it should be done gradually. On parts that are liable to become obsolete soon, prices should not be changed, but the time on all new work going into the shop should be set upon a premium basis. In doing this no consideration should be given to former piece-work rates, save as a record of time consumed. No trimming should be done, as it has after consequences. Either to change over is beneficial or it is not. If you change over, do it thoroughly or let it alone. By acting fairly and following the rules of the game, no discord will result, and in three months a considerable saving will be noted.

An Illustration of Trend of Costs

It was my intention to show how, under the premium system, a man might earn more than under the piece-work system, at much less cost to the manufacturer, but as it has always been our practice never to cut prices, either premium or piece, I find it impossible to make such showing from our records. The assertion is true, however, with regard to any shop where prices are cut when a man's earnings exceed a certain amount, because, as I have stated in a previous article, the man soon learns where the line is drawn, and that it is as easy for him to earn money working slow as it is working fast. Instead, is a standard record card, on which day-work entries are shown in black, piece work in red and premium work in green, showing how a price may be reduced in changing from piece to premium work, even to an unjust degree—provided it is not done too often and the employee has faith in the ultimate good intentions of the employer. The record card shows that the cost under piece work was $2—and incidentally shows some mighty poor guessing on the part of the setter. Under the premium system, the average cost is 69 cents. The record also shows that the estimated minimum was set too low. Assuming, however, that the allowance be raised to 3 hours and 45 minutes, which would be very liberal, and the average time consumed to be 2 hours and 30 minutes, the average cost would then be 62½ cents for a 20-cent man, and he would make 25 per cent. on his wages.

This record, see Fig. 1, has been chosen to show an extreme case of how a price may be reduced without causing any trouble. All allowances about which a complaint is made are investigated and if it is shown the complaint is justified, the allowance is changed, for two reasons: first, because it is the company's policy to be fair with its men, and second, because it pays to increase the allowance to a fair basis, as otherwise the men arrive at the same conclusion as they do in regard to piece work—if they cannot make money there is no use hurrying. Consequently, the cost to the company increases not only by the one-half they would save, but the job is often loaded with time from some other job, in order to lower the premium on that one.

The thing to guard against, however, in connection with changing allowances already set, is that the time is not intentionally prolonged in order to raise the allowance. We have had the men make the proposition to the foreman to set premium allowances at the time shown on the records for day work. This is invariably refused, as it is desired to allow the men no voice whatever in fixing allowances. Numerous strikes and countless disputes have been, and are, the results of their having a voice in setting *piece-work* prices. If you have any trouble in this respect, investigate your foreman's methods, and let the men understand that what is not right will be made right, but that you personally must be assured that it is right before it is settled.

A superior officer once informed me that as the men were directly concerned in the price set, it was no more than fair that they have a voice in the setting. I asked him to consider carefully what his statement meant, and where it would lead to, and if he were then of the same opinion I would do as he wished. I believe he took my view, as the matter was not brought up again.

I have also been asked: "Are not such methods too drastic, do they not make the men dissatisfied?" My answer to that is, "Yes! For a time." But under any conditions, save of their own choosing, dissatisfaction is bound to occur among a certain class of employees, and by taking this matter out of their hands gradually, we have removed one prolific cause of dissatisfaction. The principle being established, the newcomer takes it for granted. It may border a little on paternalism, but most of us like a little of that if it is not too patent.

Pace Makers

Our present system of setting allowances works very satisfactorily and makes the hold-up process practically impossible. For instance, in a certain department the work is divided into four broad classes. Two pace-makers are selected on each class of work—men known for their skill and honesty. These pace-makers are given all the new work, as far as possible. It has been found that 10 per cent. added to their minimum time makes a fair minimum for the other men. The pace-makers receive the benefit of this 10 per cent., and 50 per cent. is then added to this as a premium allowance. Premiums complained of as too low are also referred to them. The jobs done by them are checked up by records of similar jobs in the office, so that generally a fair premium is arrived at. So far, not a single allowance has been objected to, nor an objection entered by the cost department, and a much better feeling has been engendered in the department, increasing the output about 30 per cent. Many instances where there was a deadlock between the cost department and the factory, owing to the foreman's attitude, have been settled. Another feature that has been noticed, is that several of the men have taken exception to the assumption that the pace-makers were 10 per cent. faster than they were, and have asked that 10 per cent. be added to any premium allowance set on their time. This is granted where the skill of the man and the records justify it. It has also been noticed that some of the men always endeavor to beat the record of the pace-maker. This is not encouraged, however, as quality is always considered before quantity. More speed, either in the pace-makers or other workmen, is not desired.

In using pace-makers, there are two things to be figured out: First, how much faster the pace-maker is than the No. 2, or high-grade, speedy man; and second, how much the pace-maker will increase his speed on the same job at subsequent trials. On the class of work referred to, which is entirely independent of machine help, it has been found that if given the same job again, the pace-maker decreases his time from 10 to 15 per cent. It is not expected, of course, that the average man is going to make the maximum premium at his first trial, as prices are not set on that basis. The way it works out is that the pace-maker on old work is generally able to make 25 per cent. more premium than the man in the next grade. In my estimation, this is as it should be, and our company has adopted the principle of allowing its exceptional men all they can earn, even though the pay of some runs very high. The criterion is not what *they* can do, but what other men can do, and when a man gets to be in this class he is usually indifferent as to what other men may say of his industry, or his running more than one machine.

Another Illustration

The second card, Fig. 2, is interesting as showing another phase of the question, a decided reduction being made in the original cost and men still making an excess premium. The piece price, as shown on this card, was $1.75 each; the average time 3 hours. This is not shown on this card, as the figure 2 in the upper right hand corner denotes another card before this. The first entry, in black, shows a beginner doing the operation on day work. The next entry is the same boy, who has received a raise, and has evi-

dently made good, as shown by the reduction in time. The next five entries are those of men apparently trying to boost the allowance. The letter *A* over these columns denotes that the cards were gone over at this period; the *X* over the fourteenth entry was placed there at the time the cards were looked over, and when the card was filled to that space, it was kept out for checking. That the operation was simple is shown by the fact that these same men reached the time of "A. B., No. 291," who is a speedy man, in subsequent trials.

These cards show considerable variation, and what might be termed rather poor judgment in setting allowances—one being too low and the other too high. There are several reasons for this, however:

First. That the machine element does not enter into the operation at all.

Second. The, then, foreman was antagonistic to premium work, and not reliable in his time setting.

Third. Types and methods were new. We, therefore, had no records to compare with. But they emphasize a point which I have sought to bring out, that is, to be careful of every allowance, as the aggregate of a lot of bad setting is very costly.

Another abuse which the premium system prevents is the habit of some foremen of setting a piece price on small and single jobs. This is not prevented primarily by the premium system, but by the method of time comparison and records, so that snap judgment on either the part of the foremen or the office is prevented. This practice is more prevalent among foremen than is generally thought to be the case.

The whole operation of changing over from piece to premium work, then, can be epitomized in "Use common sense and judgment," for after all is said and done, it does not require great talent and intellect to manage a large manufacturing plant; for, as someone has said, "The path of success in business is invariably the path of common sense," and "common sense" is not the exclusive vassal of any one class or condition of men.

Reciprocating Fixture for the Milling Machine *By A. J. Baker**

In an earlier article some milling fixtures were illustrated which were of the "rotary" type. It is intended here to deal with fixtures which may be classed as reciprocating, that is such as are used in cases where the table feeds back and forth, and two fixtures are employed, one of which is being loaded, while the other is worked upon. While this arrangement necessitates a double traverse of the work, it is perhaps the nearest approach to the rotary method of milling that can be employed. It has furthermore the advantage of a double or finishing cut, for although no change is made in the hight of the knee or head, yet the return stroke takes out all the spring in the cutter and work, and gives a light scraping cut.

Milling Oil Pump Castings

In the first example, Fig. 1, a No. 3 Cincinnati vertical milling machine is shown milling the main surface of an automobile oil-pump casing. These are made of malleable iron, with about 1/16 inch of metal to be removed. There are two halves, both of which are accommodated in the same set of fixtures by simply changing certain loose screws, and the gripping plates. The piece is supported on three fixed points marked *A*, in Fig. 2, and additionally supported by the vertical plunger *B* which is moved up through the medium of the horizontal plunger and nurled-head screw, which will be seen at the front of the fixture. The actual holding of the work is accomplished by two swinging jaws, which are forced against the round boss, and the flat side by the two large hexagon head screws seen in the side view.

These jaws in addition to moving in, are so placed that the gripping edge is vertically over the axis, and consequently as they move forward they also move down. This, of course, tends to force the work more firmly onto the support points. Two separate fixtures are provided, and the machine is equipped with the automatic reverse feed, which permits the operator to devote the whole of his

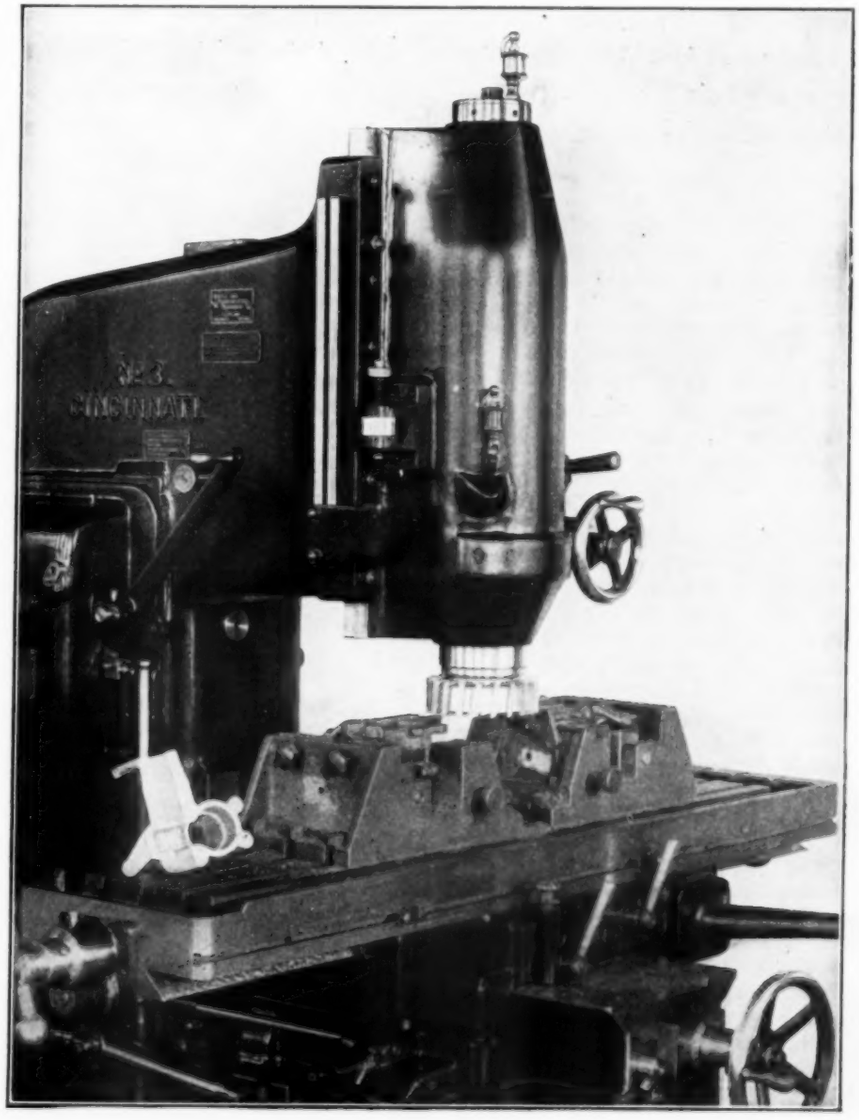


Fig. 1. Milling Oil-pump Casings

*In charge jig- and tool-designing department, Cincinnati Milling Machine Company.

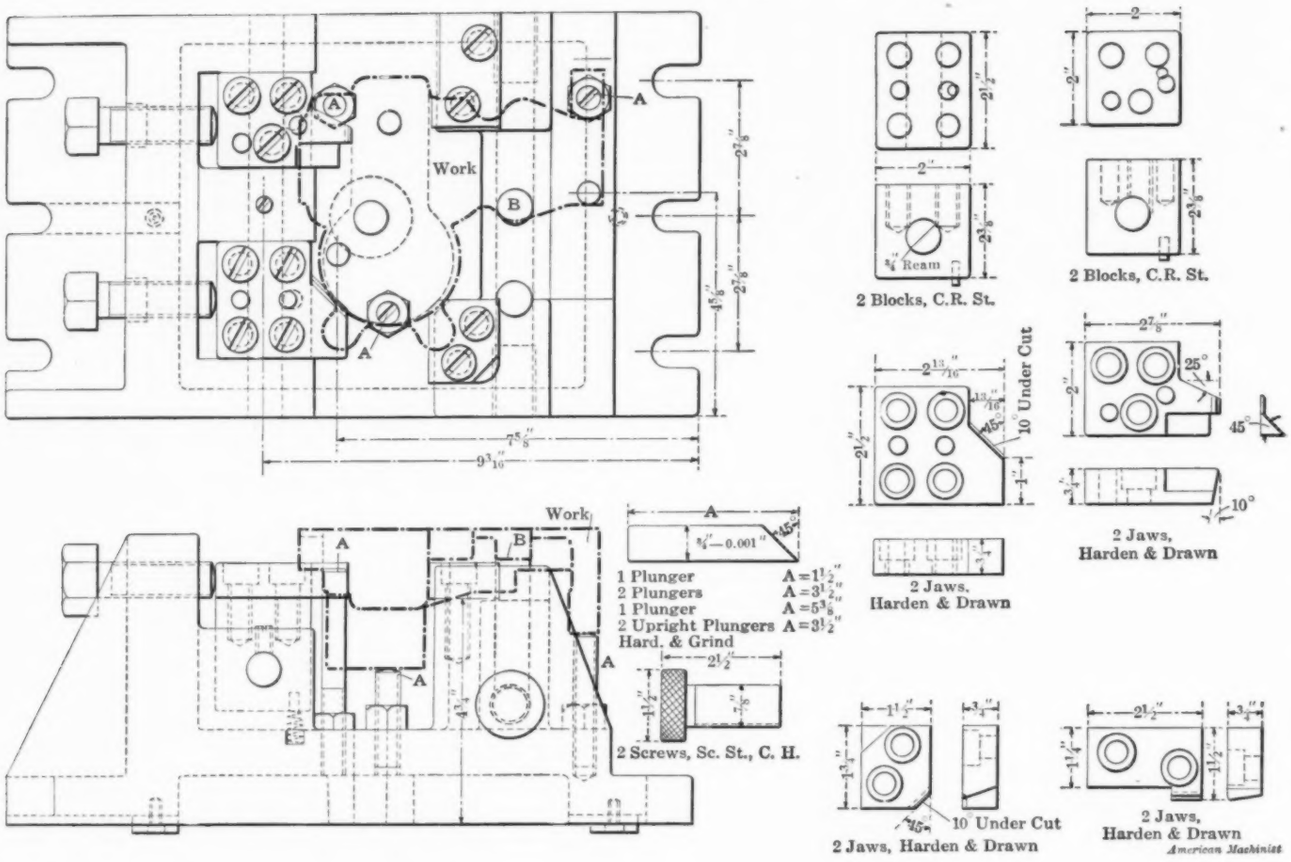


FIG. 2. FIXTURE FOR MILLING OIL-PUMP CASINGS

attention to inserting and removing the pieces.

CONVENIENCE AND RAPIDITY OF OPERATION

The fixtures may be so placed on the table, that there is just time for one piece to be removed, and a fresh one substituted, while the cutter is operating over the other fixture. This, it will be seen, reduces the milling time of the piece to the limit imposed by the capacity of the operator to handle the work.

In this example the width of the cut was 6 inches, and length of cut 7 inches. The cutter, which was a 7½-inch standard face mill, was run at a speed of 56 revolutions per minute, and the table fed at the rate of 16 inches per minute. This gives a milling time of 1¼ minutes per piece.

MILLING VISE BODIES

The second of this series is shown in Fig. 3, which illustrates the rough milling of a No. 3 milling-machine vise body. The arrangement of the machine is similar to that shown in the preceding example. The machine is a No. 4 Cincinnati vertical fitted with 10-inch high-power cutter. The fixtures are also of the vise type. They consist of a body carrying three fixed support screws and two fixed gripping pieces shown at *C* in Fig. 4. These gripping pieces are inclined on the working face, and acting on the flange of the work, force it down into the supporting points. The moving jaw of the fixture is free to rock or swivel in a horizontal plane around the body. This permits of its adjusting itself to the rough casting. The thrust of the clamping screw is taken up by a hardened steel plug driven into the movable jaw. In operation the right-hand fixture is first filled, and the feed started. When the table has traversed the requisite distance for milling the work, the feed reverses, and the operator without leaving the front of the machine,

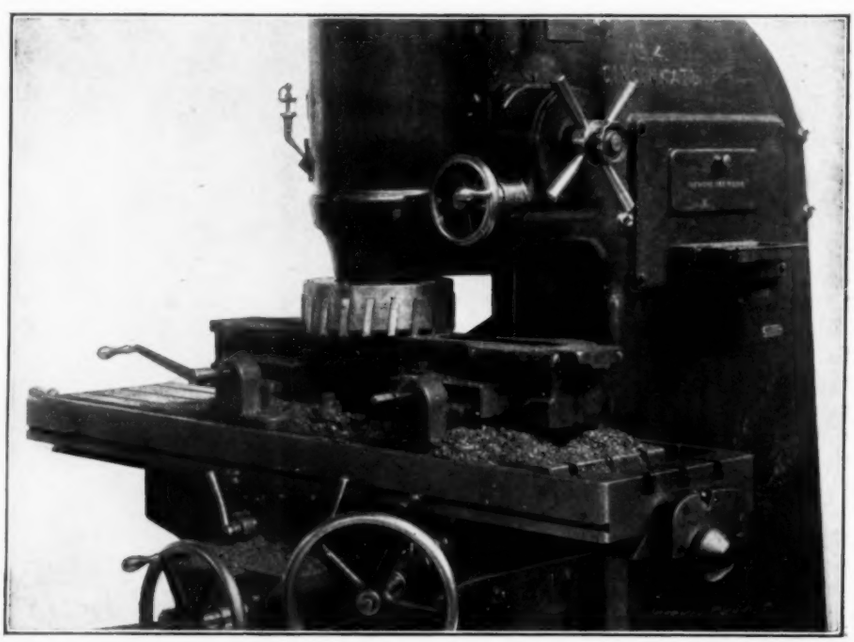


FIG. 3. MILLING VISE BODIES

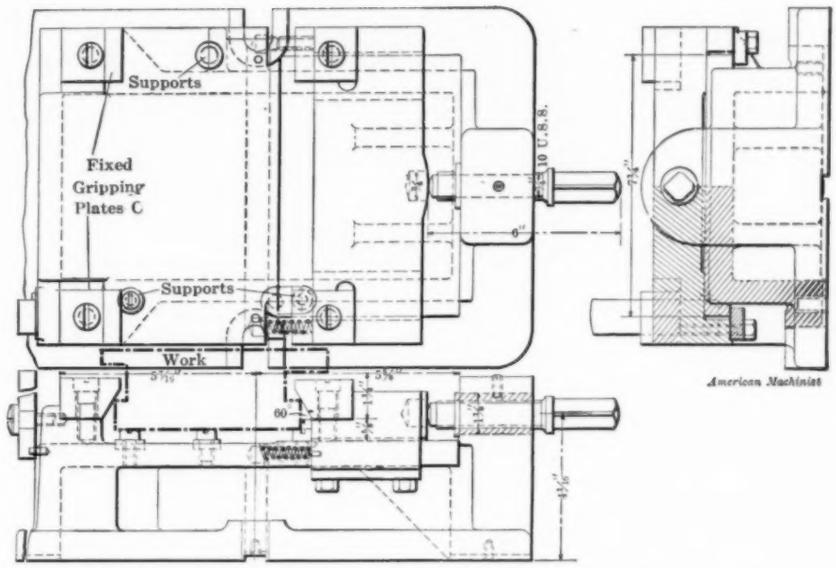


FIG. 4. FIXTURE FOR HOLDING VISE BODY ON MILLING MACHINE

leans over the table and raises the feed-change lever from the position "4 B. C." to "4 B. D.," which means that the roughing feed of 7¾ inches per minute is changed instantly to a finishing feed of 20 inches per minute. This is, of course, done without stopping either spindle or feed. The table now traverses to bring the left-hand fixture, which by this time is loaded, toward the cutter. When it has closely approached the cutter the operator again changes the feed lever, and drops back to 7¾ roughing feed and so on, repeating the operation for each piece of work.

WHY FEED CHANGE IS MADE

It may be asked why a feed of 20 inches per minute cannot be maintained both for roughing and finishing. The answer to this question would be that at such a feed the amount of material to be removed, often reaching ¼ inch in depth, would break out the edges of the work, and give an unsightly job. The width of cut in this case is 8½ inches, the length 15¼ inches and the milling time 3¼ minutes per piece.

The application of the method outlined above should be made where the quantity of pieces does not justify the cost, or where the size or shape of the work prevents an economical arangement of rotary fixture.

The Various Effects of Sulphur in Steel

By F. F. Lake

Sulphur is one of the native elements of the earth that is found in large quantities, free from combinations, especially in volcanic regions, as well as combined with metals in the form of sulphide. Sulphur is given off from the fuels used in refining steel and in the high temperatures combines with the oxygen of air in the form of a dioxide SO_2 and a part of this is liable to be trapped in the metal unless precautions are taken or slags are used to remove the sulphur.

When in steel in the form of sulphide it causes it to crack, tear and check in rolling, forging, heat treating, or hot-working, and therefore the term of "hot shortness" has been applied to its effect on steel. This is the opposite of the effect of phosphorus. Its effect on the properties of steel when cold have not been accurately determined, but it seems certain that the effect is not detrimental to any extent.

When steel is heated beyond a dull red, sulphur in the sulphide form is said to cause a crystallization to take place, and when high temperatures are reached the grain becomes very coarse as the sulphur is dissociated and forms into a gas that diffuses between the iron crystals thus separating them and preventing perfect cohesion. When contraction by cooling takes place this may cause microscopic cracks, or even cracks large enough to be seen by the naked eye. These, of course, weaken the metal.

Sulphur takes two forms in steel, one of which is sulphide of iron, and the other sulphide of manganese. Iron sulphide (FeS) usually forms when the sulphur is high and the manganese low, as sulphur has a greater affinity for manganese than for iron. Until the manganese is satisfied, sulphide of iron is not liable to occur, and this latter form does not often occur in commercial steels. It is more brittle than manganese sulphide, and at the proper temperatures for rolling steels is in a liquid state, thus there is no cohesion between it and the molecules of steel. Instead of coming together in drops, as manganese sulphide does, it spreads out in webs or sheets, which are very pale in color and usually completely surround the manganese sulphide. When rolling steel these are made to cover a comparatively large area and the effect of iron sulphide is thus very injurious to the metal, as it is weak and liable to break along these webs or sheets. Owing to its liquid state iron sulphide is more liable to cause trouble at the rolling temperatures whether this temperature be used for rolling or for forging, welding or heat treating the steel.

Sulphide of manganese (MnS) is formed by the uniting of manganese and sulphur and is invariably found in steel; this being the form that sulphur takes in all the good grades of steel, and if there is enough manganese present all of the sulphur in the metal will assume this form. It usually forms in globular spots, but when the metal is rolled or hammered, these generally elongate and under the microscope they show a pale slate or dove-gray color.

Opinion differs as to the injurious effect of manganese sulphide upon steel, but, however this may be, it is not as injurious as iron sulphide. It has been melted in coke-fired assay furnaces that would not melt mild steel, which would indicate that it was injurious when steel was heated to comparatively high temperatures. It frequently occurs with manganese silicate (slag) and it segregates together with phosphide of iron in the form of ghosts. In this case it may be very injurious to steel, and especially so where the sulphide is magnified by rolling the metal.

Sulphur, when added to soft iron that is low in sulphur, increases the strength of the metal, partly by closing the grain and partly by increasing the combined carbon. Owing to this tendency to increase the combined carbon and form an iron carbide, it has a hardening effect on the metal. Its effect on the tensile strength of steel has not been definitely settled, but up to 0.10 per cent. it does not alter the elastic ratio, elongation or reduction of area to any extent. The actual percentage of sulphur at which steel ceases to be malleable or weldable varies with other ingredients. Each increment of manganese raises it and it is lowered if the steel ingots are cast too hot.

Attention is being turned to the effect of sulphur, noted in the preceding paragraph, and the old theory that sulphur should be reduced to a mere trace in steel is beginning to be doubted, as some of these effects could be made beneficial if the injurious effects could be overcome. Some recent investigations have led to

the belief that the oxides are the real source of weakness and failures in steel, and if these can be removed, the injurious effects of sulphur can at least be nullified with a probability of its being made beneficial.

The Cause of Hotshortness Probably Not Due to Sulphur

In the manufacture of "ingot iron," a metal in which the impurities have been reduced to as low a point as possible commercially, to make it as nearly noncorrosive as possible, the oxygen has been materially reduced in percentage. In perfecting the process it was at first difficult to make metal that would not blister and crack on the edges when rolling. By abandoning the use of ferro-manganese and using ferro-silicon, or a material that acted similarly, to remove the oxides from the bath and afterward treating with less than 0.1 per cent. of aluminum in the ladle, these difficulties were overcome. This would seem to add further evidence to the theory that it is not sulphur but oxygen, which is probably present in the metal in the form of oxides, that causes the hot-shortness met with when rolling, forging, welding, or heat-treating steels.

The Bad Effect of Sulphur Probably Exaggerated

According to the old theory, 0.08 per cent. of sulphur made crucible steel absolutely worthless for welding, forging, rolling, etc., but I have recently seen samples of crucible steel that had the oxides reduced to a minimum, and the sulphur at 0.08 per cent. that were forged under the steam hammer without any signs of checks. Another piece of this same steel which contained 0.60 per cent. of carbon was welded onto machinery steel to form the cutting edge of an ax, and apparently the weld was perfect as there were no signs of a crack when it was ground to shape. This ax was stood on an anvil with the cutting edge up and given 20 blows with a heavy sledge before the edge broke, and even then the weld was not harmed. Another test was to drift a hole 4 inches in diameter in stock 1½ inches thick and 4 inches wide without destroying the drift. In still another test a ⅜-inch set stood 200 blows from a 12-pound sledge without breaking. This same set was then used in the daily work at the mill until it was worn out and it outlasted two sets made of stock steel. The tensile strength was a little better than the ordinary in this high-sulphur steel.

With steels as ordinarily made at present the sulphur should not exceed 0.10 per cent. for any use, but for toolmaking or other uses where the metal has to be repeatedly heated and cooled this should not be over 0.03 per cent., and preferably as much lower as possible. Steel as now made would be much better for nearly all kinds of work if the sulphur could be reduced to a trace.

Automatic Machine for Winding Different Shaped Pole Coils

The edgewise winding of pole coils with copper bands by hand has proved to be a very tedious and expensive process. In order to attain a cheaper method, the Schweizerische Werkzeugmaschinenfabrik Oerlikon, at Oerlikon, near Zürich, Switzerland, has placed on the market a new machine by which the manufacture of such coils can be carried out with amazing rapidity and therefore at a considerable decrease in cost.

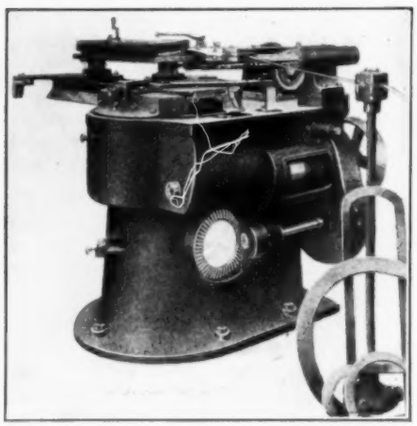


Fig. 1. Automatically Operating Coil-winding Machine

The machine works entirely automatically. The magnet mandrel is fastened to its slide, the copper band is clamped in its holder and then the mechanism operates until the spool has received a sufficient number of windings. The machine is driven by a belt pulley and a spring friction coupling. The tension table, which at the same time acts as a slide, has a combined motion, either a simultaneous rotary and longitudinal movement, or only a rotary one. The rotary movement is transmitted by a worm, and the longitudinal by rack and pinion, etc. These two motions have a common drive and are interchangeably put in operation by the reversing lever and coupling.

Coils of any desired shape and of varying sizes, are produced to equal advantage on this machine. The accompanying

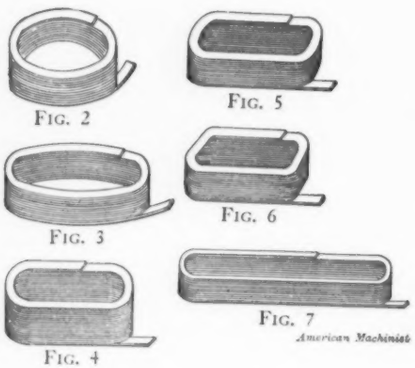


Fig. 2. Fig. 5. Fig. 3. Fig. 6. Fig. 4. Fig. 7.

Some of the Coils Wound on Automatic Machine

figures, 2 to 7, show a few usual forms. Copper bands from 0.04 to 0.55 inch thick, by 0.70 to 2.65 inches wide, with any proportion of breadth to thickness, are wound without difficulty, assuming that the radius of curvature is not less than the width of the band.

It will handle oval or rectangular coils up to 39 inches long or the same diameter of rounds, with any number of windings, the machine weighing about 4400 pounds.

Automatic Devices for the Mints

It is announced that machinery is in the very near future to make some material savings in expense at the United States mints located in Philadelphia, Denver, San Francisco and New Orleans. The devices in question are an automatic weighing machine and an automatic feed for the stamping presses.

At the present time each coin is weighed and "adjusted" by trained operators, mostly women. The automatic weighing devices will do this mechanically.

The automatic press feed is said to be the invention of a mint employee. Formerly, the coins were fed into tubes by the press operators and automatic fingers drew out the bottom coin, placing it under the dies to be stamped. By the new device, the coin disks are poured into hoppers which hold a supply good for forty minutes, these being automatically and continuously fed to the presses without the attention of an operator for each press. An electrical device acts to automatically stop the press at the instant that any disarrangement causes a stoppage in the feed. As the coinage of the several mints involved reached the enormous figure of 173,000,000 pieces last year, using the hand feed, the saving by the automatic devices may be appreciated.

Interesting Machine Tools of German Design and Make

Distinct Features of Three Types of Standard Machines

Special Correspondence

The accompanying halftones illustrate a number of interesting machines constructed by the firm of Gildermeister & Co., Aktiengesellschaft, Bielefeld, Germany.

Milling Machine

The first of these machines, illustrated in Figs. 1 to 5, inclusive, is known as a rapid universal milling machine. It is of rigid design, especially constructed for using cutters of high-speed steel and adapted for taking heavy cuts. It has positive spindle and feed drives through gearing, the arrangement of which will be understood from the halftone engravings. The drive for the spindle, which is journaled in long adjustable bronze boxes, is derived primarily from a wide belt pulley which, as shown in Figs. 3 and 4, actuates a long pinion journaled in a sleeve and adapted to drive a pair of intermediate gears which in turn may be engaged as desired with any of the four gears forming the cone on the miller spindle, as illustrated in Fig. 5. This four-step gear cone, with the double driver illustrated in Figs. 3 and 4, provides at once eight speed changes which can be doubled by means of the back gearing, giving a total of 16 rates of speed.

The method of supporting and adjusting the intermediate gears will be obvious upon inspection of Figs. 3 and 4. As represented, these gears are carried in a strong double yoke which is supported upon the long sleeve through which the driving pinion passes, the bearing surface of the yoke upon the sleeve being sufficient to enable the former to be readily adjusted, when changing the position of the gears. The supporting sleeve, as indicated in Fig. 3, is drilled to receive the conical point of a screw operated by the hand wheel shown in that engraving, and upon the adjustment of the intermediate gears to the required position the hand wheel is turned to force the cone point of its spindle into the proper hole and thus hold the mechanism in place.

The drive for the feed gearing is transmitted from the main drive through a positive connection as illustrated in various views and here again a handwheel is resorted to in making the feed changes. The location of this wheel will be seen in Fig. 2, where it is shown at the right-hand side of the column, slightly below the end of the work table. In changing the feed this handwheel swings over the curved surface shown, which is drilled at various points as represented, to locate the position of the handwheel for the different feed changes. The eight rates of feed obtainable in this manner are doubled, giving a total of 16, by means

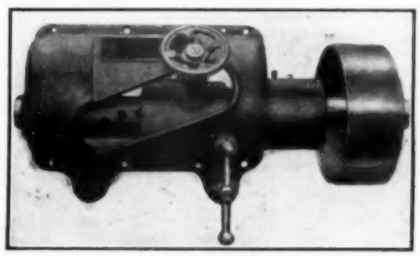


Fig. 3 Drive Gearing for Milling Machine

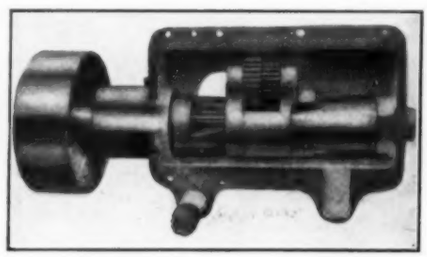


Fig. 4

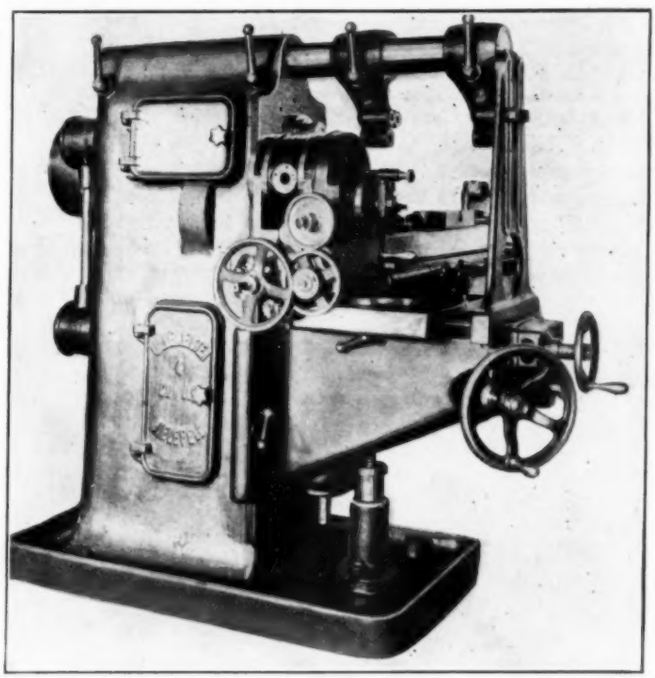


Fig. 1 German Universal Milling Machine

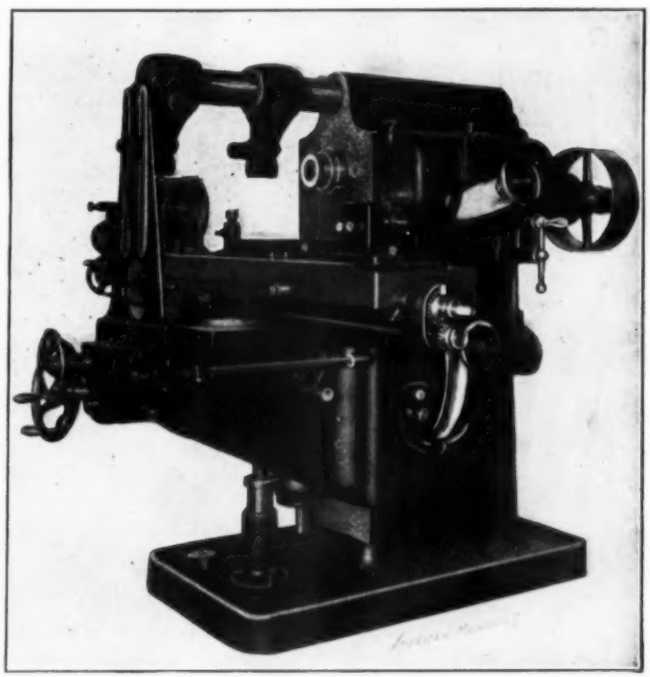


Fig. 2

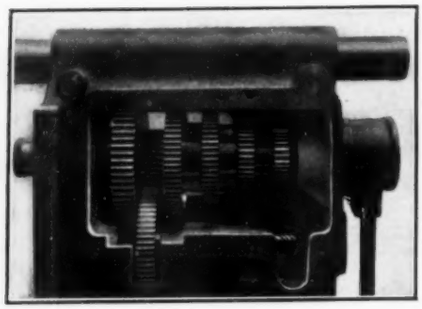


FIG. 5. DRIVING GEARS ON MILLER SPINDLE

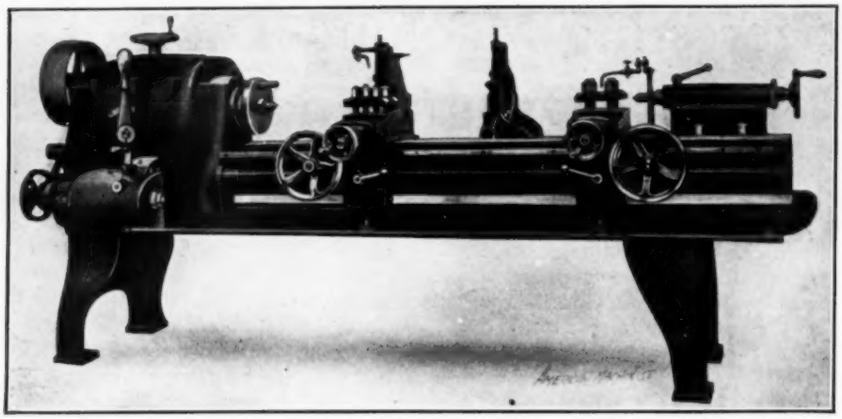


FIG. 6. GERMAN LATHE FOR RAPID TURNING

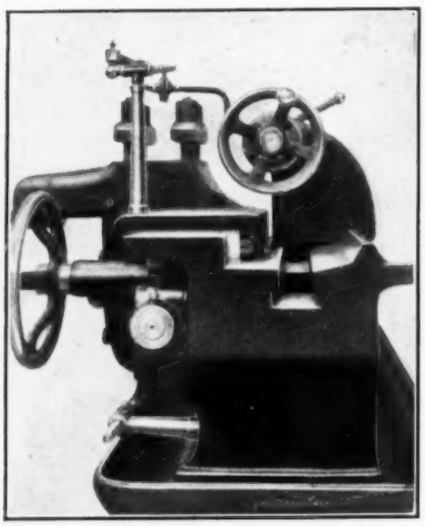


FIG. 7. END VIEW OF LATHE

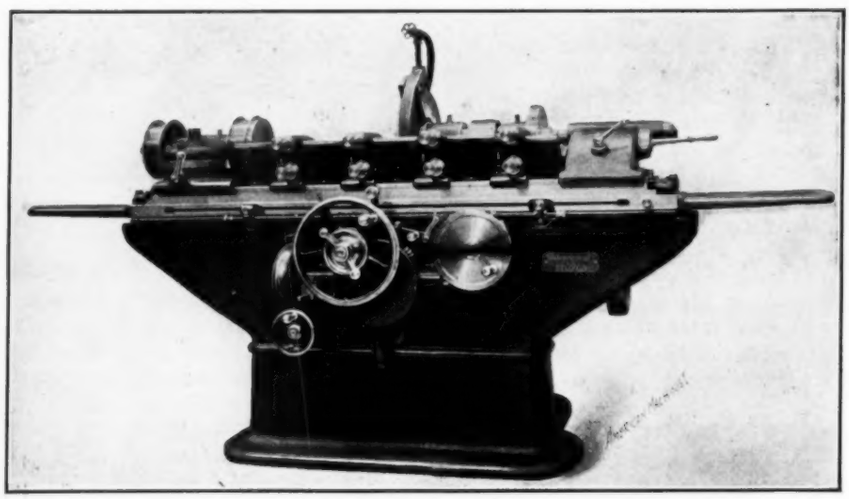


FIG. 10. GERMAN UNIVERSAL GRINDING MACHINE. FRONT VIEW

of the short crank handle shown below and to the left of the wheel.

LATHE FOR RAPID TURNING

The lathe in Fig. 6, which has a center hight of 200 millimeters, is equipped with a geared head for driving the spindle and gear mechanism for the feed screw for turning, change gears being provided to enable screw-cutting operations to be performed also.

The design and arrangement of the carriages will be of interest. Two of these are shown on the lathe and the general form will be understood from Figs. 6, 7 and 8. They are narrow with simple slides for carrying the turning

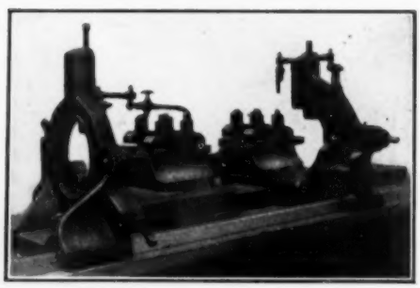


FIG. 8. THE TWO CARRIAGES AND RESTS

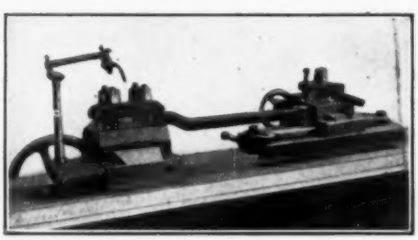


FIG. 9. TAPER-TURNING ATTACHMENT

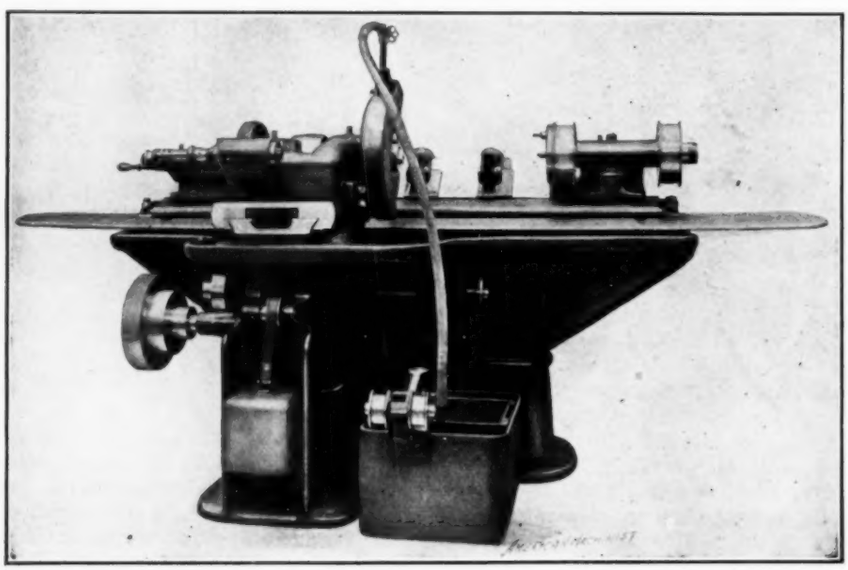


FIG. 11. GERMAN UNIVERSAL GRINDING MACHINE. REAR VIEW

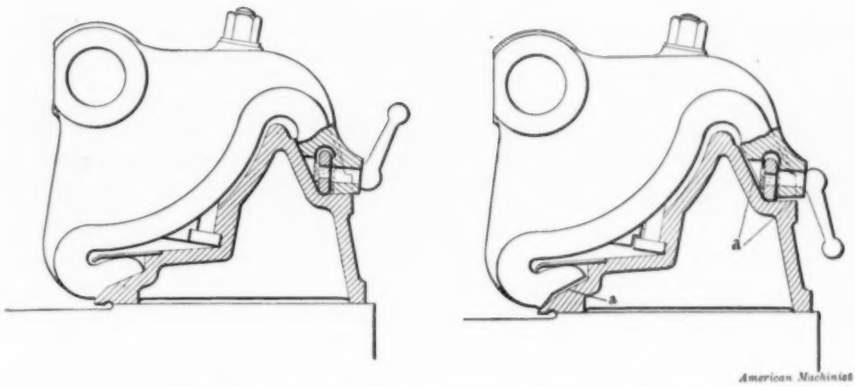


FIG. 12. METHOD OF MOVING TAILSTOCK WITHOUT WEARING WAYS

tools, and are made practically without aprons or complicated gearing. The carriages are low, afford a very solid support for the tool and are well adapted to sustain the pressure due to heavy cuts. The lathe ways are shown by Figs. 7 and 8. Referring to these illustrations, the carriage will be seen to take a bearing at the top upon a flat way dovetailed at the outer edge and provided with a gib at the back, while the front and lower end of the carriage is guided against a flat surface in the vertical plane, the ways thus being practically formed on the front vertical face of the bed.

The feed screw is located midway between the two guiding surfaces, thus avoiding tendency to twist the carriage when in operation. The form of the tool rest on the carriage is such as to permit the work to swing close to the bed and furthermore the carriages may be run completely past the tailstock as indicated in Fig. 7, the tailstock as there shown having special ways, one of an inverted form and the other a narrow flat way.

The method of turning tapers is illustrated in Fig. 9 which shows a fixture which may be used at any desired position on the bed. The taper bar on this attachment is readily adjusted to the required angle and the tool slide is operated by a link which is connected to the regular slide on the other carriage. As shown, the lathe is equipped with oil pump, reservoir, pan and piping.

UNIVERSAL GRINDING MACHINE

The grinding machine illustrated in Figs. 10 and 11 has a center hight of 250 millimeters and grinds a length of 1000 millimeters. The headstock of this machine and the wheel carriage are arranged to swivel, and the table also may be swiveled for taper work. The table is, of course, equipped with automatic feed, with automatic reversal, the cross movement of the wheel carriage at each stroke being also accomplished automatically. An interesting feature is shown in Fig. 12, which illustrates the form of the ways and the shape of the headstock and tailstock, the latter being so constructed as to slide on special bearing surfaces, thus relieving the regular ways of wear due to more or less constant adjustment of the tailstock on the bed. The unequal wear upon the bearing surfaces due to movement of the tailstock along short portions of the bed is here obviated by lifting the tailstock by means of a roller on an eccentric stud operated by the handle at the front, thus clearing the tailstock from the regular ways at the points indicated by the arrows *a*, Fig. 12.

A grinding machine of the same dimensions is also built for plain cylindrical work.

Rolled Finish for Motor Shaft Journals

By Robert Reid

The problem of securing an ideal finish on the journals of shafting is one that to some extent we are all familiar with, and possibly a great many readers of this article have had considerable personal experience in securing a surface that would pass inspection. In order to secure the most perfect journal, a number of years ago some of our large railroads instituted a series of experiments with the axle journals of their cars. The journals were turned up with the greatest of care, filed and polished in the most approved manner and sent out on the road, a very accurate record being made as to results. Other journals, after being turned and filed, were finished by rolling; using a hardened steel roll and pressing the same up against the surface to be finished, producing an exceedingly smooth surface. These in turn were sent out on the road for trial purposes. The results showed that under certain conditions the rolled journals gave the best results.

Various schemes for rolling journals have been devised, but that in the figures shown is so much different from the usual that it may be of interest to have it described.

The main part of the device consists, as may be seen in Fig. 1, of a very substan-

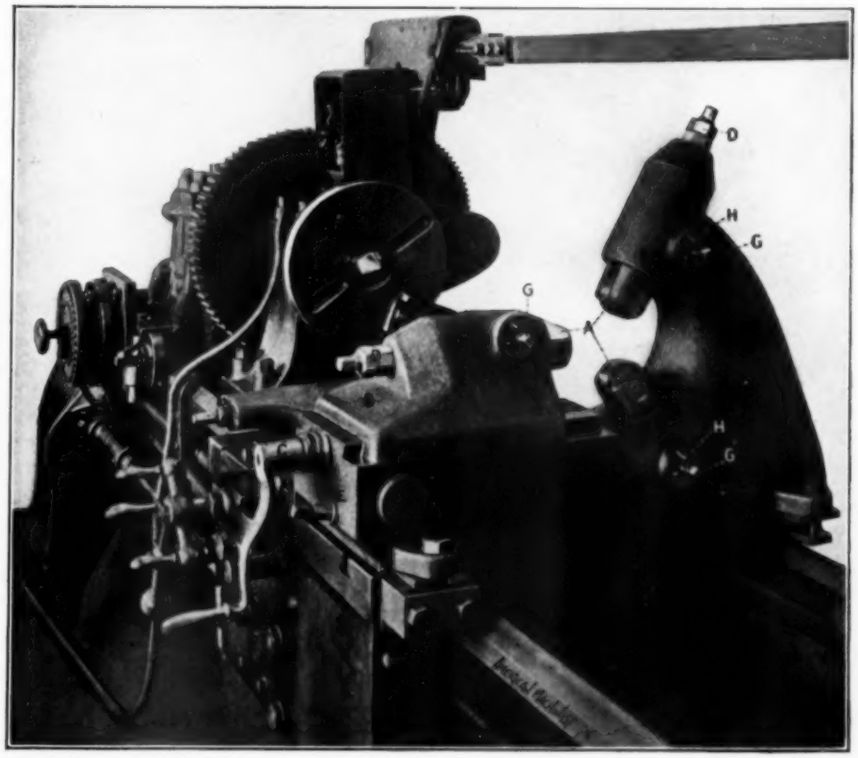


FIG. 1. SHAFT-ROLLING DEVICE WITH SHAFT REMOVED

tial casting, of such shape that it may be mounted upon the carriage of an ordinary lathe. There are three rollers, shown at *A*, 2½ inches diameter by 1⅛ inches face; two of them being mounted in the main casting, while the third or front roll is carried in the horizontal cross slide *B*. The adjustment of this slide for applying the required pressure for rolling the journals, is made by means of the screw *C*, similar to the ordinary slide rest. The rolls are adjusted to the different size journals by means of the screws and lock nuts *D* and *E*. The device shown is capable of handling journals varying from 1½ inches to 6 inches diameter. The end of the screw for the adjustment of the lower back roll being inaccessible, a small worm wheel is placed thereon, and this in turn is operated by a small worm on the end of an inclined shaft, which brings the adjustment of this roll up in front, at *E*.

The rolls, which are extremely hard and highly polished, are carried in hard bronze bearings, carefully fitted in the ends of cylindrical steel bearings, or plungers. These plungers may also be turned slightly from the neutral position in either direction, this neutral position being that in which the axes of the rollers and of the shaft are all parallel.

The object of this adjustment is as follows. The rotation of the rolls being due to their pressure against the side of the revolving shaft, it follows that when the roll is in the vertical position there is no tendency to move the roll sidewise, but as we turn it in either direction, there is a tendency to do two things; one of these is the turning of the roll on its axis and the other, the effort of the roll to move or creep along the shaft. This force, resulting from a slight inclination of the roll, is sufficiently powerful to render unnecessary the use of any power feed on the lathe carriage. This adjustment of inclination of the rolls is obtained by the screws *G;* while the amount of the inclination of the roll is shown by the graduated dial *H*.

In practice, the shaft, having been turned, is rough ground, and then rolled. While some very good work has been done in rolling the shaft after it has been rough turned, in order to secure the very best results, as to its being absolutely true and free from any possibility of the compressed metal slivering off in the course of time it was considered advisable to rough grind the journals before rolling. After grinding it is placed in the lathe centers for rolling.

The lathe being started, the two back rolls are adjusted until they are rotated slightly by reason of their contact with the journal, after which the cross slide carrying the front roll, is moved up. As may readily be seen, the forcing in of this roll, by means of the powerful screw, also brings the other rolls into action and the pressure is distributed equally on the three rolls.

On several occasions during the experimental stage, after the shaft had been rolled, a number of curious markings were discovered, looking, to the naked eye, very much as if the surface of the shaft had been etched by acid. Various ideas were advanced as to the cause, and it was only when the magnifying glass had been brought into use that the cause of the markings was made clear. The operator had wiped the rough-turned shaft with a piece of cotton waste, the fibers of which had passed between the shaft and rolls, the pressure being sufficiently great to actually force the cotton fiber into the steel. This seemed almost incredible, and it was only when the experiment was tried that the result was verified.

It has been found advisable to place the rolling device next to the tailstock and to do all the rolling at this end of the lathe, as it gives the operator more freedom. It is also best to start rolling at the end of the journal nearest to the headstock, turning the shaft end for end and also to adjust the rolls in such a manner as will cause the carriage to travel toward the tailstock. This places the entire backward thrust which is due to the inclination of the rolls upon the live center, and as the shaft and center turn together, there can be no distortion

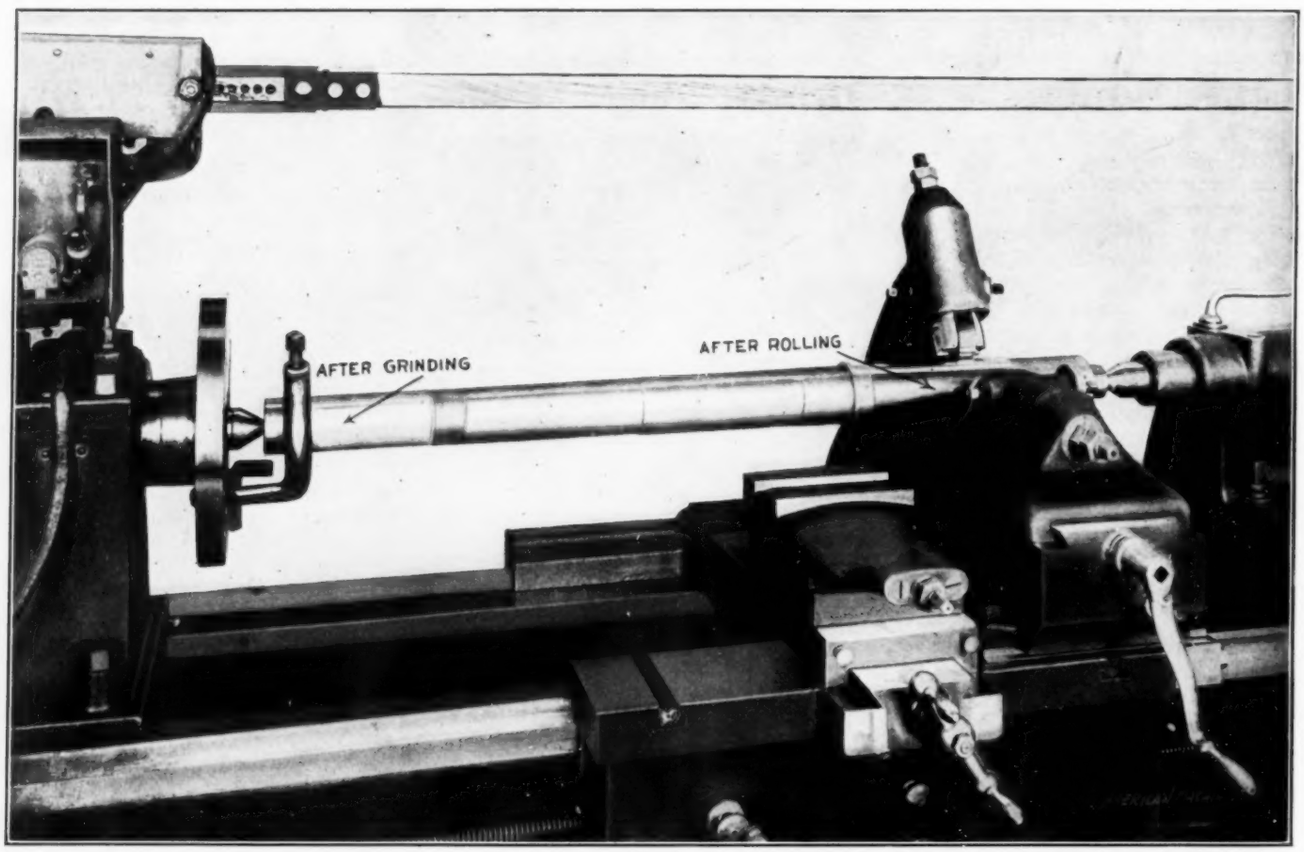


FIG. 2. DEVICE FOR ROLLING JOURNALS FOR MOTOR SHAFT

of the centers nor springing of the shaft, as in the case of a single roll pressed against a shaft, which is of necessity held between the two centers.

At first glance, the movement of the carriage toward the tailstock would seem to place the pressure upon that center, relieving the live center from all pressure. This would occur if the carriage was moved by friction or power feed. It must, however, be borne in mind that, inasmuch as the shaft is the prime mover, giving motion to the rolls and these in turn to the carriage, in order to move the carriage there must be a pressure along the shaft in a direction opposite to that in which the carriage moves. Then, when this movement is toward the tailstock, the backward thrust must be toward the live center.

In the device shown, when all three rollers have been brought into slight contact with the journal, the tailstock center may be run back considerably, so that there is absolutely no contact or pressure between it and the shaft.

Another feature which is very important is as follows. With a single roll pressing against the shaft, the roll is very apt to move according to the density of the metal. If there are any hard spots the roll will be forced back, while if there are any soft spots the roll will crowd in. The result is a journal very much out of round. In the new device this objectionable feature is entirely done away with, by reason of the shaft being rigidly held between the three rolls so that if a hard spot should occur, tending to push one of the rolls away from the shaft, this tendency is immediately opposed by the resistance of the other two rolls. The result is a journal exceedingly accurate in its diameters.

The result of this rolling is to give a surface which seems to be almost perfect; hard and smooth. It can be picked out at a glance by reason of the bright, silvery appearance which it takes on, instead of the grayish color of the turned and filed journal, while its appearance under the magnifying glass is also very much improved.

By reference to Fig. 2 some slight idea of its finish may be obtained, the journal at the left end being as it came from the grinder, while that in the rolls shows the surface after rolling. Here we can see the reflection of the upper back roll and bearings on the journal.

The device has passed the experimetal stage and has now been in constant operation about one year, giving entire satisfaction; especially upon the journals of General Electric Railway motors, the requirements of which are of a very high order.

It is the invention of John Riddell, mechanical superintendent of the General Electric Company and was designed by him to meet this demand for high-grade journals.

A Discussion of the Merits of Concrete for Shop Floors

Some of the Claims and Objections on This Important Question

By Leonard C. Wason*

During the past 15 years the Aberthaw Construction Company, of Boston, has often been asked whether cement or wood-topped floors were preferable for factories and similar buildings. Owners have often adopted the wood-top floor, in spite of its higher cost and the longer time required for construction, because they feared the cement surface would not wear well, and in part because they feared their operatives would complain if compelled to stand on a masonry surface.

The AMERICAN MACHINIST'S editorial on page 279, on the objections of workmen to concrete floors in machine shops, touches in an interesting way some of the facts that appear in an investigation of the subject of concrete floors that is now being conducted by the Aberthaw Company. A brief account of some of the points that this investigation has so far brought out, applying more particularly to the machine shop, may serve to stimulate a closer inquiry by manufacturers into the common prejudice of workmen against the granolithic floor. When the company has completed its inquiry and has studied the material obtained, it intends to prepare a detailed report on the matter, with a statement of such conclusions as the evidence may justify. These deductions should be of practical value to the manufacturer and the architect in determining the kind of floor surface that will best meet particular sets of requirements.

THE LETTERS OF INQUIRY

In order to secure as complete a record as possible of experience with granolithic floors, my company has recently addressed letters of inquiry to a great number of manufacturing concerns, asking for their judgment, based on their own experience, first, as to whether a granolithic or other masonry surface floor is actually bad for operatives standing upon it; and if it is bad, why. Secondly, what other objections there are to granolithic finish that make it advisable to go to greater expense for some other wearing surface.

THE REPLIES IN GENERAL

The replies so far received have brought out, as was to be expected, great diversities of view on both the main points of inquiry. Generally speaking, the replies as to the effect of granolithic floors upon the operatives are of four sorts. First, there are the cases in which operatives complained, while new buildings were going up, of the prospect of having to stand on concrete; but did not actually complain when the test came. Second, there are the cases in which workmen complained of new granolithic floors for a time, but apparently got used to the surface, so that their complaints ceased. Third, there are the cases in which operatives complained continuously, and provided themselves, when their employers did not do it for them, with boards or wooden gratings to stand on. Fourth, though this class perhaps should have been put first, there are the cases where the report is, "Never had any trouble or complaints."

The replies of the first group naturally ascribe the objections of the workmen to unfounded prejudice, which is said to have gradually disappeared on better acquaintance with granolithic floors. The second group of replies allows for prejudice, but assumes that the men really had to get used to the new surface; but that it finally ceased to bother them. It is in the replies of the third group that there appear, very naturally, more signs of sympathy for the workman's complaints. These replies show that the complaints have been regarded as proof of actual bad effects from standing on a granolithic surface. Some employers regularly provide wooden platforms for their machine operatives, counting this an inevitable drawback to the advantages for which they have adopted concrete floors. The general complaint from the operatives is that standing still on a concrete floor tires them, especially their legs, makes their feet sore, and produces rheumatism. In plants where such complaints are made, the trouble seems to be confined to men whose work keeps them standing in one place; those who are

*President, Aberthaw Construction Company, Boston, Mass.

moving about seem not to be troubled by the character of the floor. Some employers have very strong views on this discomfort to the operative, and declare that the strain of standing on concrete impairs the workman's health, spirits, and efficiency to such an extent that the avoidance of these results would be economy at a cost many times greater than that of wood floors.

Quotations Showing the Opinions

Here are brief excerpts from replies, which fairly indicate the variations in opinion:

"Our main shop, which is entirely under one roof and covers an area of approximately 300x500 feet, has a concrete floor 8 inches thick, with the exception of a small area in the blacksmith shop, which is a cinder floor. When it was decided to use a concrete floor throughout the shop, we heard many rumors that our men would quit because the concrete would be too hard for them to work on, and they would have a great deal of trouble with their feet. The writer, who was in charge of a great deal of the new construction work on this building, was told by some of our old employees that they would absolutely refuse to work on a concrete floor and would leave their job as soon as we put the floor in. These men are still with us, and we have had no further complaints about a concrete floor being hard on the men's feet. We can therefore state, from our own experience, that a concrete floor is not injurious to the men working on it."

"We have made a careful inquiry among our employees in regard to the cement floors being cold on the feet as compared to a wooden floor, and in most cases we learned that while concrete was colder, it was not so cold as to be objectionable."

"We had some little complaint at first, but after our operatives became accustomed to it, we think that they are practically as well satisfied as with the wooden floor."

"Our machine department, however, a building 55 feet wide by 250 feet long, has a concrete floor which thus far has given satisfaction. This department has been in operation three or four years and we have heard no complaints from the workmen in reference to the floor. We favor granolithic floors where possible to use them."

"The entire floor space of our building is made of concrete construction, and up to this time we have never had any complaint in regard to the same."

"As far as the men are concerned, we provide machine operators with a platform on which to stand, as the complaint is quite general, that standing on a concrete floor is very hard on the feet, and tends to fatigue men excessively. We are considering various materials for these platforms, such as wood, or compressed cork, etc."

"I was superintendent of a factory for quite a long time, in the wood-working department of which was a granolithic, or granitoid flooring. I found that this was a very hard floor for the men to work on, inasmuch as at least 75 per cent. of them were bothered with sore feet."

"We see no objection to these floors, as far as the operators are concerned, although part of our men, particularly those who have to stay at one place most of the time, have wooden platforms to stand on raised a little above the floor so as to give them a little spring, although some of the men only use a board. We think there is less attention paid to this, even by those who made some complaint at first, after getting used to the hard floor, than there was at first."

"I do believe that a granolithic or other masonry surface is bad for the operators, because a hard floor is tiresome to stand on. It is cold and damp, and I have known of such floors apparently making the men sick."

"We consider the cement top floor actually bad for a man's health, as it seems to wear the men completely out, and is liable to make them take cold or give them rheumatism. We have several of our shops equipped with cement floor, but in each case, we have wooden platforms built for our machinists to stand on."

"As to the question of standing upon an earthen substance—this is known to be very bad for the individual, as it is purely a question of conductivity, from the fact that masonry will draw the animal heat from a person very much faster than is the case with wood; and which results in a tax upon the system and certainly has to do with the health and earning power of an operative. This fact alone, in the writer's opinion, is of a hundred times more importance than any difference in the cost of the two classes of flooring."

Concrete Floors as Conductors of Heat

Undoubtedly the American Machinist has accurately stated the cause of workmen's complaints as being the coldness, and not the hardness of concrete floors. Every small boy knows that the coolest seat on a hot day is a smooth stone door-step. Like the stone door-step, a concrete floor feels colder than a wood floor. The low heat conductivity of wood as compared with concrete, is plainly the real cause of the preference of many operatives for the wood floor.

A concrete floor is a good heat conductor, and when it is not only not heated, but is in outward contact with the ground or with the outside air in the winter time, it actively transmits cold to its inner surface. At all seasons, however, the concrete floor "feels colder" than the wood floor, solely because of its greater heat conductivity. Explanation of the effects of this greater conductivity on the operative carries us into physiology. Take, for example, the editor's desk slide, and the telephone that stands upon it. These two objects are subject to the same outward temperature conditions, yet the metal telephone stand "feels" much colder than the wood of the desk. The fact is that when the hand grasps the metal of the telephone, this metal, which is a better conductor than the wood of the desk, rapidly draws the heat from the surface of the hand, and this lowering of the surface temperature produces on the surface nerves the effect which gives the sensation of coldness. In the same way, the concrete floor and the stone door-step are "cold" on a warm day because they rapidly conduct heat from the surface of the body that is in contact with them. The effect of this rather rapid heat conduction on the operative who stands for hours in one place is gradually to chill his legs, and thus slow the circulation in them. This physical state of affairs might easily give rise to sore feet, owing to the continuous pressure on certain muscles and skin surfaces in which the circulation has been slowed by the withdrawal of body heat into the concrete floor; lameness and stiffness of the legs would also be a logical result in some cases. Moisture on a concrete floor serves to increase the heat conductivity of the floor surface.

The heating of concrete floors by a system of imbedded pipes or hot-air ducts, as described in the article on the heating of the Morse Chain Company's plant, American Machinist, page 246, would seem to dispose once for all of any just cause for complaint against such floors on the part of operatives. Whether or not floor heating by internal ducts is in all cases the most effective and economical way of meeting the problem is a question that will bear more study. This problem is one for the heating engineer to solve, and does not concern the concrete contractor until it is necessary to settle the relation between the pipes or ducts advised by the heating engineer, and the requirements of a proper reinforcement of the floor concrete. It is perhaps a sign of hitherto inexact scrutiny of the problem that hardly any of the replies to our inquiries make any mention of differences in "coldness" between concrete ground floors and concrete upper floors. The principle of heating concrete floors would seem to be involved in the comparative behavior of ground and upper floors of this material.

The superior "elasticity" of the wood floor, though it is to some extent a factor in the problem, is pretty certainly not a large factor. In a floor consisting of a maple top laid at an angle to plank

which rest upon concrete, there is a certain slight amount of give under the impact of a man's step, because there is always some actual space between portions of the two layers of wood, and the seven-eighths maple overlay will bend a little under a moderate weight. This deflection is so nearly infinitesimal, however, under most conditions, that it can hardly contribute much to the characteristic "feel" of a wood floor. A more important item is that even maple dents slightly under the impact of the nails in boot-heels, while on a granolithic floor the shock of impact in walking is not thus softened, but is transmitted like a hammer blow to the whole body. In the case of wood gratings laid upon concrete floors, some employers speak of these as being "elastic," or "flexible"; but there is plenty of evidence that the operative is about as well satisfied with a piece of stiff board. Boards and gratings act as insulation from the "cold" granolithic floor, and this function is the really significant one.

Wearing Qualities

In regard to the wearing qualities of granolithic floors, a large proportion of the replies from machine shops are more or less unfavorable. The chief items of complaint may be listed as follows:

1. Liability of granolithic surface to wear into hollows, or ruts, under heavy trucking.
2. Liability to cracking and splitting out of pieces when heavy machines or heavy castings with sharp edges are moved over it.
3. Cracking away of the cement from industrial rails.
4. Dust, due to abrasion of the floor surface, which is sometimes merely disagreeable, but which in some cases works damage to machinery and product.
5. Difficulty of making effective repairs to granolithic finish.

The excerpts from replies given below will show in more detail the objections that come under 1 and 2.

"Regarding the granolithic floor for factories . . . the chief objection is its liability to wear in ruts under heavy trucking, and the difficulty of making repairs."

"I consider cement or granolithic flooring the best for machine or other metal-working shops. The only objection to it is its non-resilient property, but I do not consider this serious. Its cleanliness and durability offset all other objections."

"With the incoming of concrete construction we have found that . . . . through the movement of the feet of an ordinary operative small particles of sand are disintegrated from the surface of the concrete floor and later cause dust of a character that is very damaging to machinery and often to the finish on certain classes of our product. For this reason we are using wooden floors in all of our buildings, even when constructed of concrete."

"We are using a great deal of cement floor in our machine shops, and find . . that in rolling heavy castings over it, it abrades badly, owing to the sharp corners on rough castings, and finally has to be patched. As this is a difficult matter to do satisfactorily, it has caused us considerable trouble where the patched part joins the original floor."

"As a general proposition, I consider the cement floor far superior to a wood floor for factory purposes. We have laid over 120,000 square feet of this floor during the last season."

"In a place where there is much trucking, cement floors have a tendency to wear in hollows."

"We are operating large machine shops. . . Our objections to granolithic or cement floors are that they are apt to crack or chip on account of handling heavy machinery upon them, and that they cannot be replaced or patched as readily as wooden floors."

"We are not sure that we are right in deciding to use the cement floor with the granolithic top, but we know of no way to satisfactorily determine it. The most that we can say is that we prefer it, on account of absence of fire risk and as more sanitary, cleanly, and generally better suited to our work. We believe there are many manufacturers, however, who do not agree with us, and who prefer to use wood floors."

How to Meet the Objections

Good workmanship directed by a proper theory of construction, will, in my opinion, substantially dispose of the first four objections. In my judgment, based on experience covering many years, a properly laid granolithic floor will provide a hard wearing surface that will stand up under severe usage; that will not be dusty; and that will be practically waterproof. To get such a surface, care and experience in manipulation are necessary. The aggregate must be material that will not pulverize under abrasion, that is not brittle, and that has sufficiently rough surfaces to insure a tight bond between aggregate and mortar. A round quartz pebble, such as is often used in roofing, will not pulverize, but it is so brittle that it might shatter under a sharp blow; and it has so smooth a surface that it is likely to come out of the mortar, leaving its print in the surface. Sand is made up of small, shiny, brittle grains, which tend to come out precisely in this way, and abrasion of any sort tends to disintegrate the surface of such mortar finish in detail. In order to protect the mortar, and to get a hard wearing surface, it is necessary to select a tough, hard stone of fair size, which under wear will present stone faces that will not disintegrate, and that are large enough and irregular enough to retain the bond between the mortar and the piece of stone. If you imagine the surface of a piece of finish made in this way you will perceive that at first only small points or flat surfaces of the larger stones will be presented to the wear of trucking. At first the mortar will wear slightly under usage, but finally the wear is all taken up by the pieces of stone, which protect the mortar around them. If only the wear comes from the surfaces so large that they rest on two or more stones, it is impossible to get at and disintegrate the mortar until the stones themselves are worn down.

The complaint of poor wearing surface commonly comes from factories where heavy material is moved on wheeled trucks, which usually have small diameter wheels. Where most of the trucking goes on, regular ruts are sometimes worn like those found in a roadway, and if the floor surface is marked into squares, the edges of the joints are broken back. The truck wheels commonly used are perfectly flat, usually with square edges, and it will be observed on examining these that the edges are often nicked, showing that much of the weight and wear comes on the very edge of the wheel. Suppose the wear to be more or less concentrated on the edge of a wheel, it will be seen that in effect this is a cutting edge carrying considerable weight, and that only the very hardest of material would stand up under this. Granite itself would surely be worn down if weight were concentrated on the edge of a wheel and this wheel drawn rapidly over the stone. Exaggerating, it would have the effect of a cutting wheel, such as a wheel for cutting glass. When a flat-wheel truck turns, the edge of the wheel scrapes into the surface because the load tends to tip the truck toward the outside of the circle on which the load is turning, bringing the load toward the outer edge of the wheel. This operation repeated often enough will dig up any surface that can be produced, and this is the wear that concrete floors get very commonly. Wear from the dropping of heavy castings or metal bodies from a hight, or the rolling of heavy castings, cannot be escaped by any floor, and it is probable that a well built concrete surface will bear up as well as anything that can be made.

The proper laying of concrete and granolithic floors gives opportunity for a high degree of skill in manipulation, and in my judgment all the serious defects of some existing granolithic floors would have been avoided by use of proper materials and methods. It must, of course, be admitted that patching up a chipped and broken granolithic floor can be only a makeshift sort of repair. The true way to deal with chipping is to have the floor properly laid in the first place. Properly laid, a granolithic surface, even under severe usage, will not chip or crack to

such an extent as really to impair its serviceableness and convenience. That many floors do crack and chip badly does not seem strange to one who has made a close study of the matter under the tutorship of actual construction work. Finally, it must be remembered that no floor, of whatever material constructed, can be immune to wear, and the problem of granolithic floors is not a question of whether such floors wear out, but whether they wear out more or less rapidly, and with more or less serious consequences than other floors.

This discussion of the problems of granolithic surface is confessedly not exhaustive, but it has seemed worth while as a means of perhaps inducing manufacturers to make a more searching examination of the matter, as it is presented in their own buildings. Long experience with granolithic floors justifies the belief that a clear idea of the difficulties to be met goes a long way toward solving the difficulties. When the roll of the evidence is made up, and conditions are accurately known, the Aberthaw Construction Company will present the facts and its findings thereon in a report which will be sent to those who are interested.

Rough and Ready Method of Cutting Threads *By E. P. Buffet*

If any reader of the AMERICAN MACHINIST finds himself stranded on a desert island and there has need to cut precision screws with only a jackknife and a piece of wire available as tools, he need not despair of performing the operation. With a small round clamp, a piece of lead and a few other sundries he may out screws still more precisely.

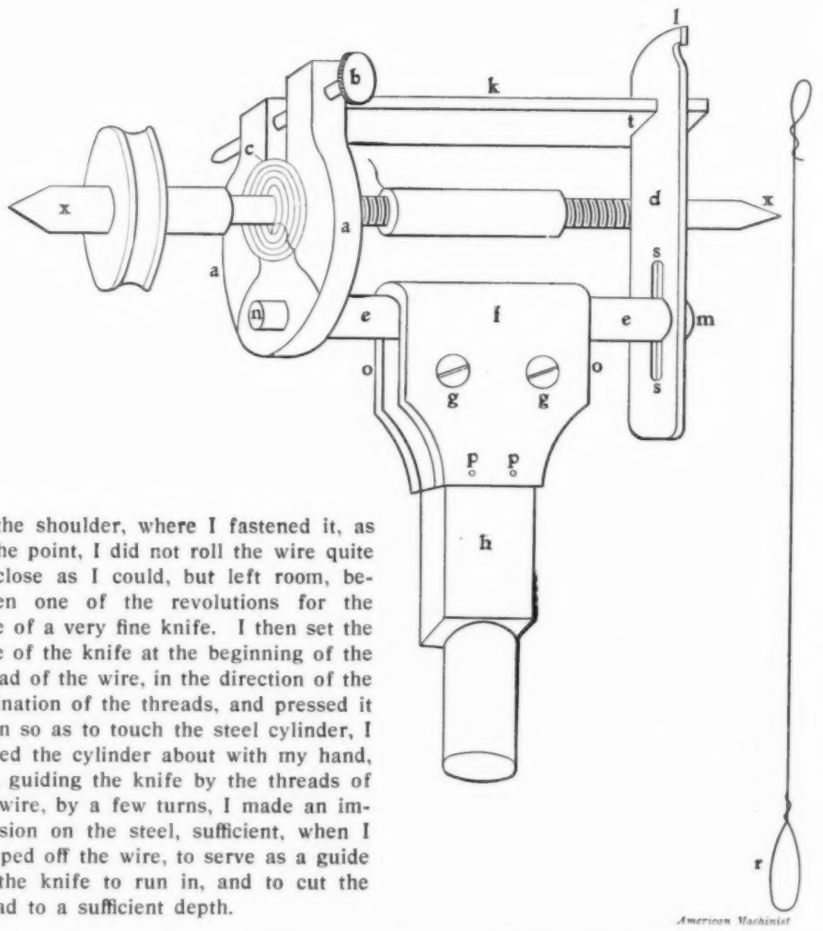
The methods here to be described were devised by the Rev. Gilbert Austin, A. M., M. R. I. A., an amateur astronomer and communicated by him in a paper to the Royal Irish Academy prior to 1795. I will let him describe these processes in his own words:

A METHOD OF CUTTING VERY FINE SCREWS, AND SCREWS OF TWO OR MORE THREADS

Having lately wanted a micrometer screw, for an equatorial instrument of twelve inches diameter, made by Mr. Robinson, of Dublin, I sought in vain, among the best workmen of this town, for one which might answer my purpose. Screws of the necessary fineness are not generally used in mechanics; rather, therefore, than submit to the delay and difficulty of obtaining one from London, I determined to endeavor to make one. The machine for cutting screws of this description used by Mr. Ramsden and by the first astronomical instrument makers in London, I understood to be complex and of great nicety: such an one would not suit me. I thought I might possibly hit upon some short and simple method of making fine screws without it. That which I used I beg leave to submit to the academy, in order that they may make it public, should they think it worthy their attention, and likely to be of service to the practical astronomer, who might otherwise find it difficult to furnish himself with very fine screws for micrometers. The use of this method is not confined to the forming of very fine screws alone, but may be applied to the cutting of original taps of any size, and of any number of threads required, as double, triple, etc., for what are called swift screws, and that with much less trouble and time than workmen are obliged to spend in the common methods.

THE WIRE COIL AND THE KNIFE

I took a piece of the best steel wire, of about a quarter of an inch diameter, and about two inches long, which I turned perfectly cylindrical at one end, about three-quarters of an inch in length, to about one-eighth of an inch, or something more, in diameter. I made a nick near the point and fastened the end of a very fine piece of steel wire to it, and then rolled the wire around the cylinder, as far as the shoulder, where I fastened it, as at the point, I did not roll the wire quite as close as I could, but left room, between one of the revolutions for the edge of a very fine knife. I then set the edge of the knife at the beginning of the thread of the wire, in the direction of the inclination of the threads, and pressed it down so as to touch the steel cylinder, I turned the cylinder about with my hand, and, guiding the knife by the threads of the wire, by a few turns, I made an impression on the steel, sufficient, when I stripped off the wire, to serve as a guide for the knife to run in, and to cut the thread to a sufficient depth.



SPECIAL FIXTURE FOR CUTTING THREADS

INACCURICIES OF THE METHOD

This method, on account of the difficulty of guiding the hand, and determining the proper degree of tension to be given to the wire on the cylinder, I found subject to a considerable variation, with respect to the fineness of the screw produced. For, from the same wire, on different cylinders, Mr. Robinson made two taps, one of 80 and one of 110 threads to an inch; and I made two taps, one of 120 and one of 140 threads to the inch; and, among these taps, not above ten or twelve threads could be found sufficiently regular for use. Those, however, as workmen know, were enough for original taps, and from them, by the usual methods, I formed four very good taps, of the fineness I have mentioned. In this method I was also subject to another inconvenience, which was, that I frequently cut the wire before I had made sufficient impression on the cylinder.

I should not have mentioned this method, as I have very much improved upon it, only that its great simplicity may render it practicable by those who cannot

execute conveniently th tool for this purpose, of which I now proceed to give the description, together with the manner of using it.

Description of Special Fixture

a a is a small vise which is opened or closed, at pleasure, by the long milled screw *b;* its jaws, at *c,* are punched or cut very rough in the inside. It is fastened, on the end of the cylinder *e e,* by the screw *n,* and in a plane perpendicular to the axis of the cylinder. At the other end of the cylinder *e e* is fixed a knife *d,* turning up with a hook *l,* and having in it a long slit *s s,* by which it may be pushed on the screw *m,* so that any part of the edge which is best may be applied to cut the screw. The cylinder *e e* turns freely on its axis, and slides, in the direction of its axis, backward and forward (but without shake) in the socket *f,* which is made of a piece of brass hammered about it, and is capable of being more or less closed, at *o o,* by the screws *g g;* the ends of this brass socket are riveted, at *p p,* to the solid piece *h,* which fits the hole in the rest of a commen clockmaker's turn bench.

The bar *k* is joined on one side of the vise *a a,* and extends across to the knife, which drops into the cut *t,* in the bar, and is thus kept steady and parallel to the vise.

Preparation of Work Blank and Guide

The steel, of which the original tap is to be made, is to be prepared as at *x x,* the end is to be turned and polished; and, at the distance of the length of the cylinder *e e,* a part of it is to be turned truly cylindrical, with two shoulders, between which the wire of the size desired is to be lapped, as tight and as close as it will go, taking care that the threads do not run too obliquely, by making them, at each revolution, advance on a steel cylinder only by their own thickness.

A bit of lead, about double the length of the jaws of the vise, and about the tenth of an inch thick, is now to be bent about the wire on the steel; the tool is to be fixed in the place of the rest of the turn bench, and, pushing it near the steel wire, the vise is to be fastened on the head, so tight as to make on it an impression of the thread. The knife is then to be let down into the notch of the bar *k,* and the cylinder *e e* is to be adjusted parallel to the steel. The edge of the knife will touch the end of the steel, (the weight *r* being hung on the hook) and, when the steel is turned about by the hand, or by a bow, it will exactly cut a screw, the threads of which will be at the same distance as those of the wire on the steel, because the wire serves as an outside screw, and the lead as a screw at the inside; so that whatever motion the vise receives, from this cause, in the revolutions of the steel, is communicated by the bar *e e* to the knife; the edge of which cuts the thread on the polished end of the steel, which is intended for the original tap.

Provision for Multiple Threads

If double threads, etc., are required, there must be an adjustment, by which the knife may be moved the thickness of each additional thread; which may be easily effected by collets, or by an adjusting screw. The wire is then to be lapped on the cylindrical steel, in a double, or triple, etc., instead of a single thread; taking care that it be disposed evenly and well fastened.

Some Engine Lathe Attachments

Editorial Correspondence

The Lodge & Shipley Machine Tool Company, Cincinnati, Ohio, does a good many interesting things in the way of manufacturing gear blanks, collars, face plates and other lathe parts, by means of special devices used on their engine lathes.

One feature of interest in this connection is the employment of expanding arbors for locating and holding parts which have been bored, while facing and turning operations are performed. Fig. 1 shows a Lodge & Shipley lathe with such an arbor in position in the spindle, while on the carriage will be seen a blank which has been faced by means of two tools on the rest, one of these being a round-nose roughing tool, the other a broad finisher.

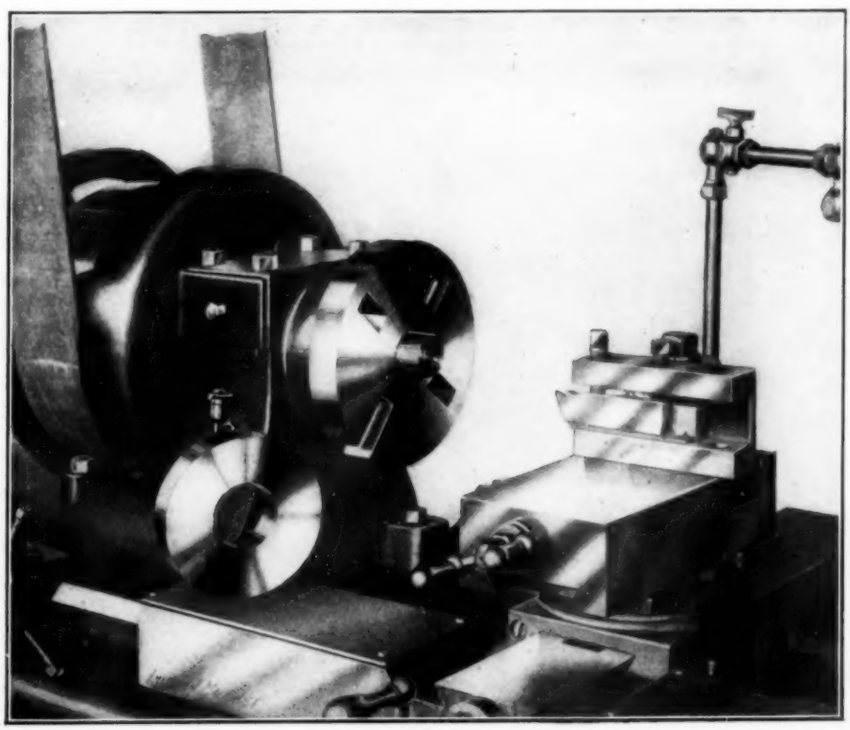


Fig. 1. Machining Work on Expanding Arbor in Lodge & Shipley Lathe

Fig. 2 shows a great variety of expanding arbors used for all sorts of work performed in this lathe. These arbors have taper shanks fitting the hole in the lathe spindle. They are split from the front end for a short distance only, are grooved circumferentially at the ends of the slots and to a sufficient depth to permit the end of the arbor to expand readily. The greater portion of the bearing surface of the arbor is finished cylindrically, and forms a plain, straight plug upon which the work is carried concentrically and without danger of being thrown out of truth by the expansion of the outer end of the arbor.

The arbor is expanded by a draw-in rod tapered from the front for a short distance to correspond with the tapered hole in the mouth of the arbor, the rod being drawn back by a handle at the rear end of the head. Upon inspection of the group in Fig. 2, it will be observed that some of the longer and lighter of these arbors are provided with pilots at the end by means of which they may be supported in an outer bearing during machining operations. Others are grooved longitudinally on one side to permit the machining of work which has been fitted with keys or feathers, the arbor in such cases being grooved to a sufficient depth

FIG. 2. EXPANDING ARBORS FOR LATHE WORK

and width to allow the work to slide into place freely.

A THREAD MILLING OPERATION WITH SPECIAL ATTACHMENT

Another operation in this lathe is illustrated in Fig. 3, which shows a method of cutting threads in face plates by means of a special milling attachment, which has proved very satisfactory.

The cutter spindle is carried in a swiveling head, bolted on the face of the turret, and is driven from a separate countershaft overhead by a universal shaft connected with suitable gearing. The work is rotated at a low rate of speed by a countershaft driven slowly by a small pulley on the main line. The carriage lead screw and the spindle are, of course, geared together as for an ordinary thread-cutting operation, and the cutter in one pass finishes the thread to within about 0.005 of size. The thread is finished to exact diameter by running through the hand tap shown at the side of the turret.

The face plate is turned, faced and bored prior to the cutting of the thread. As shown in the illustration the head and turret slide are blocked up, giving a greatly increased swing for handling large face plates.

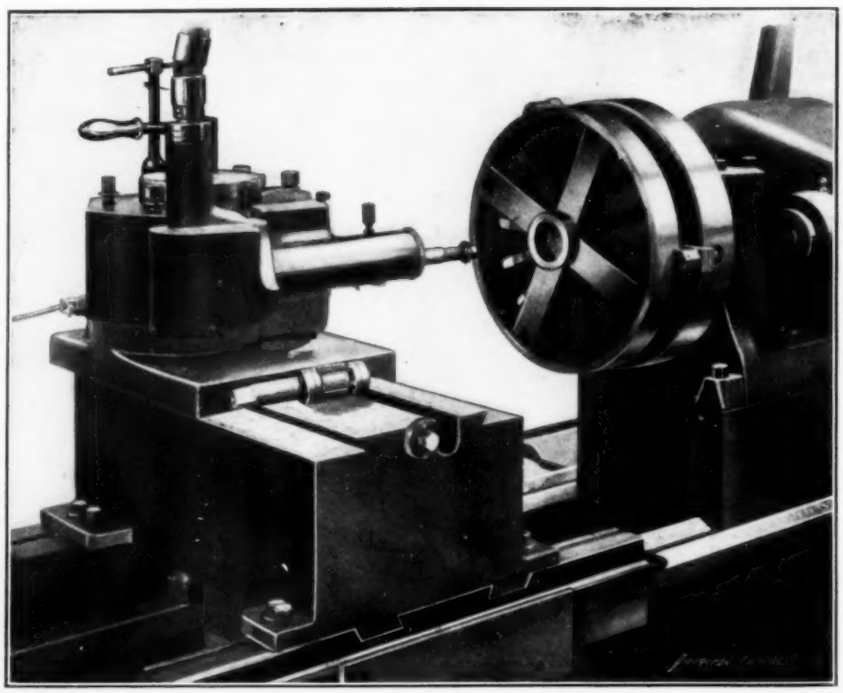


FIG. 3. MILLING THREAD IN FACEPLATE

A Fitting Recognition of Long Service

The long and faithful service of two men in a machine shop in the central West has been publicly recognized by their firm in an unusual manner. The upper half of the first page of one of their catalogs is devoted to two halftones showing these men in their familiar places in the shop; one is standing beside a large boring mill, the other is standing at his vise. Both are in overalls and jumpers and look as if they had merely glanced up from their regular work at the request of the photographer.

Under the pictures we read: "We place these pictures of our oldest employees here in this cataog to honor them for their long and faithful service. The one has worked in our machine shop continuously, with hardly a day's interruption, for the last 49½ years. The other has supervised machine work during the past 52 years."

These veteran machinists have seen half a century of machinery development with their firm, and it is a graceful act of courtesy and recognition to thus publicly acknowledge their long and faithful service on the front page of the catalog describing the machinery with which they have been so long connected. The firm referred to is the M. Rumely Company, Laporte, Indiana, and the honorable veterans are Samuel Hoover and John Hanna.

Letters *from* Practical Men Concerning *the* Details *of* Making things *in* Machine shops, *from the* First Sketch *to the* Sale

Making Currycomb Handles in Two Operations

Fig. 1 shows a currycomb handle of 1/16-inch soft steel, to be used in place of the malleable-iron handle with which currycombs are usually fitted.

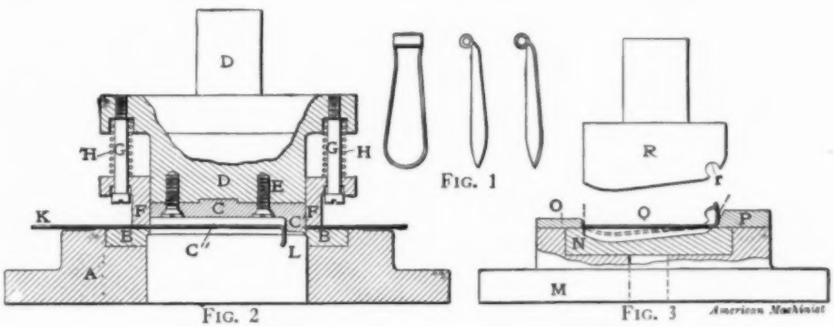


FIG. 1 FIG. 2 FIG. 3

MAKING CURRYCOMB HANDLES IN TWO OPERATIONS

The illustration shows a plan view, a side view and a longitudinal section of the handle. The dies shown in Figs. 2 and 3 complete the article in two operations.

The first operation, performed in the die, Fig. 2, consists of blanking the piece, and first bending the curled end. The die *B* is carried by the die bed *A*, of the usual pattern. The punch is composed of the cutting part *C*, carried by the punch holder *D*, a blank holder *F*, actioned by the springs *H* and guided by the guide pins *G*.

The cutting part *C* is of a peculiar shape, so that when the punch comes down the blank is cut first from the stock *K* at the extreme right end. At this point the punch is not flat, but forms a little curve inward which forms the beginning of the curl in the blank. Going further down, the stock is bent by the inward face of the punch projection *C′*, the bent part being long enough for the forming of the curl. The blanking is then completed by the face *C″* of the punch, as the punch continues to come down.

The starting of the curl at the extreme end has been found extremely useful in facilitating the forming of the curl proper, at the same time considerably reducing the wear of the die performing this operation.

The article is completed by the forming die shown in Fig. 3. A proper space is provided for the work *Q* (coming from the first die) between the gages *O P*. *N* is the die, carried by the die bed *M*. The punch *R* has a groove *r*, which forms the curl by forcing the stock around the walls of the groove, following a well known principle, while the rest of the punch forms the body of the handle, finishing the work.

At this stage, the nose forming the lower edge of the groove *r* in the punch, projects a little inside of the handle, and consequently upon the punch going upward it will carry the work with it facilitating the extraction of the finished handle.

New York. GUIDO SACERDOTE.

Different Methods of Keying Sliding Worms

At page 125, R. Nielsen describes three methods of keying sliding worms; perhaps the following descriptions of some other methods of keying fixed as well as sliding worms will be of interest. The sketches shown do not give any of the sizes, although they give a good idea of the comparative diameters of the bore and bottom of the thread.

The problem of keying is one of the most difficult to overcome when mounting a worm which is comparatively thin in what might be termed the body, on a shaft, whether sliding or fixed.

Fig. 1 shows the type of bore sometimes used for light work where the worm must be made separate from the shaft. The blanks are first rough turned, faced one end and parted off in either the automatic or the turret lathe. The hole is drilled eccentric, as shown by the dotted line, in the drilling machine for short pieces; when too long in proportion to the diameter, the blanks are chucked in the turret lathe so as to keep

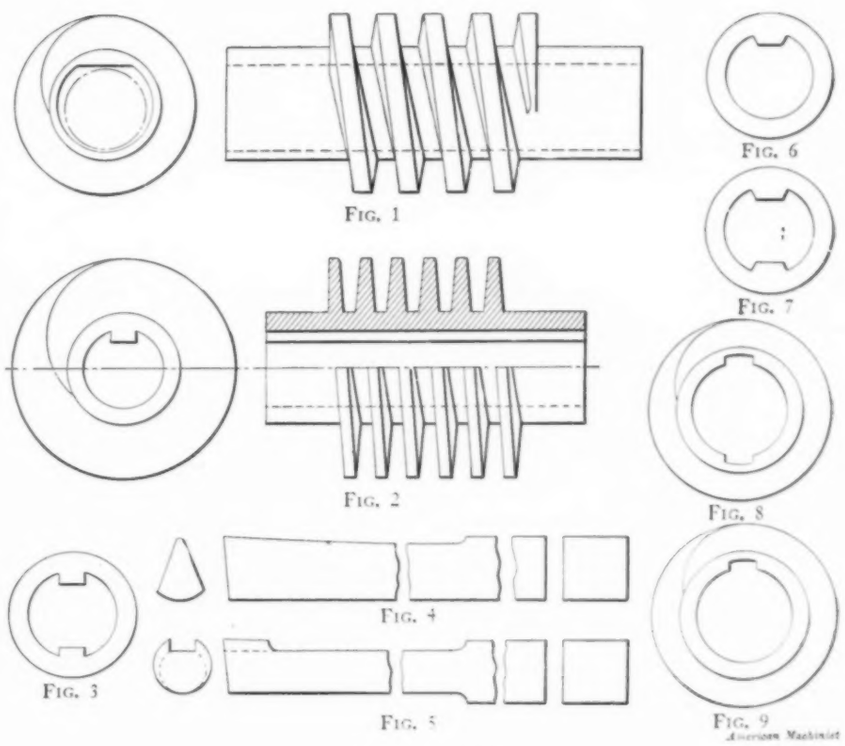


FIG. 1 FIG. 6
FIG. 2 FIG. 7
FIG. 3 FIG. 4 FIG. 5 FIG. 8 FIG. 9

KEYING WORMS

the axes parallel to each other. These pieces are slotted and drifted to gage, then passed on to the turning section for finishing and thread cutting. The sizes for which this form of hole is used vary from 0.3 to 0.6 inch diameter, the greatest length for the larger size being 2.5 inches.

For larger sizes the types shown in Figs. 2 and 3 are used for both sliding and fixed worms. In these types the blanks are rough turned, the ends faced and the hole bored in the turret. Should the key in Fig. 2 be very deep in proportion to the diameter of the hole, the hole is made eccentric to relieve the slotting as much as possible. After slotting the holes are fitted to gage by hand, this being found preferable to running the risk of spoiling any by drifting. These worms are usually made of steel having a tensile strength of 35 to 40 tons per square inch, so it is fairly hard and does not give good results when drifted, except in the D-section holes where there are no acute angles.

The slotting of these holes is comparatively easy when once the initial difficulties have been conquered. In the smaller sizes a triangular-shaped tool, Fig 4, is used for slotting the circular portion, this giving the best results and at the same time fulfilling nearly all the conditions which are incidental to this class of work. Where the holes are large enough, advantage is taken of this to use a stiff tool bar, and in all cases a gap tool, Fig. 5, of the width required, is used for finishing the keys to width.

A modification of Figs. 2 and 3 is shown in Figs. 6 and 7; in this case the sides of the keys and keyways are made radial; this, of course, brings the faces at right angles to the forces acting on them, but they are slightly more difficult to produce.

The foregoing methods may seem to be more expensive than the loose- or fitted-key method; the cost will, however, be found not much in excess of the loose-key method, while for durability the solid method has all the advantages. First cost is not, however, the only item to be considered; there are at times certain conditions to be fulfilled, when first cost is only a secondary consideration and reliability takes its place.

For fixed worms only, the types shown at Figs. 8 and 9 are used. In this case the keys or feathers are formed on the shaft by slotting or shaping, instead of in the worm. This method is highly satisfactory, both in regard to first cost and reliability.

The majority of the shafts are machined between the centers in the shaping machine, the shaft being driven with a dividing head, a ratchet on the worm spindle and connected to the ram giving the amount of feed required.

One reason for using the solid-key or feather method is that the designers employed in our concern object to patching where it is possible to make work solid. Another reason is that when worn there is not so much backlash as would be the case were the keys or feathers separate. No matter how good the work, the key will get slack in a sliding worm or pinion; more especially is this so when the direction of motion is being constantly reversed, as is the case with the sliding pinion driving the vertical screw on the wall planer.

S. O. FOWLER.

Birmingham, England.

Press Tools for Making Small Nuts

The accompanying sketches show the construction of a punch and die for making small hexagon nuts with a minimum amount of scrap and at the rate of about 30,000 an hour, or seven nuts at each stroke of the press. The die is shown in Fig. 1, the punch in Fig. 2. A section through the center is illustrated by Fig. 3.

The stock (in this case brass) is cut into strips of proper width, or may be obtained direct from the mill in the width desired. It is fed into the die at *D*, Fig. 3, under the first row of perforators, marked *E*.

After this, it is carried by automatic roll feed under the next row of perforators *F*, where the pilots *G* assist in properly locating the stock, then under the hexagon punches *H* and finally under the shearing punch *I* which shears off four

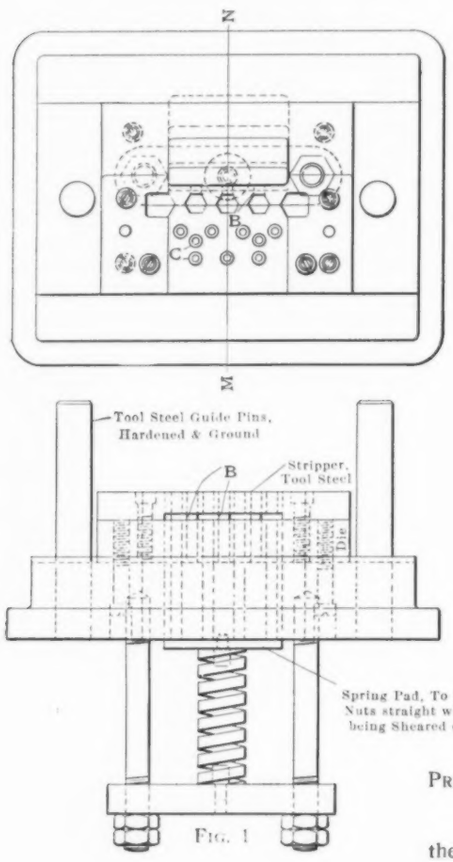

Tool Steel Guide Pins, Hardened & Ground
B
Stripper, Tool Steel
Die
Spring Pad, To hold Nuts straight while being Sheared off.

FIG. 1

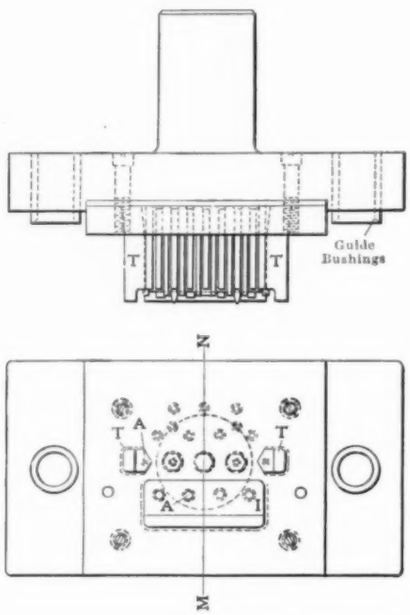


FIG. 2

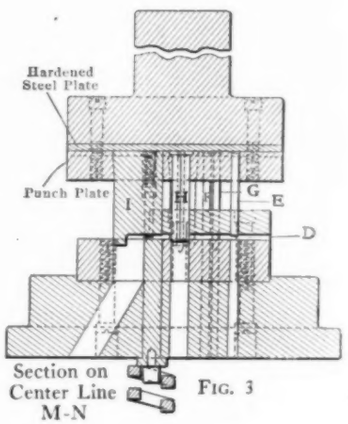


FIG. 3

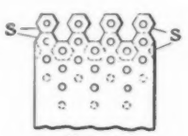


FIG. 4

Dotted Lines indicate next Operation.

American Machinist

PRESS TOOLS FOR MAKING SMALL NUTS

hexagon nuts, three nuts having been blanked out previously at *H*, thereby making seven in all.

There is no scrap between nuts; the only material that is not used is that which is cut out at *S*, Fig. 4, by notching punches *T* shown in Fig. 2, and the material that is punched out by the perforators.

Fig. 4 represents the end of a strip and shows how the die literally eats up the stock. *A* in Fig. 2 indicates small push pins that are used to prevent adhesion of the small pieces of scrap and nuts to the punch, due to the use of oil on the stock for lubricating purposes. At *B* in Fig. 1 are shown the positive stops, forming a part of the stripper, which prevent the stock from being fed into the die too far at any time, accidentally or otherwise. *C*, Fig. 1, represents hardened-steel bushings in the stripper which guide the perforators and pilots into the die and also support them while perforating.

When these holes become worn it is an easy matter to replace the bushings with new ones, thereby making the stripper last almost indefinitely.

The other details of construction will be clear from the sketches, and need no further explanation. I will state, however, that this punch and die was made for nuts measuring ⅜ inch across flats and about ⅛ inch thick.

For smaller nuts than this, say ¼ inch across flats, a punch and die constructed along these lines could be laid out to punch 9 nuts at each stroke of the press, thus making it possible to punch out about 38,000 nuts an hour, and this would require no larger press than was used in the case illustrated.

Chicago, Ill. O. R. KLEPPER.

Design of an Upright Drawing Board Frame

The accompanying cuts show a front and a rear view of an upright drawing

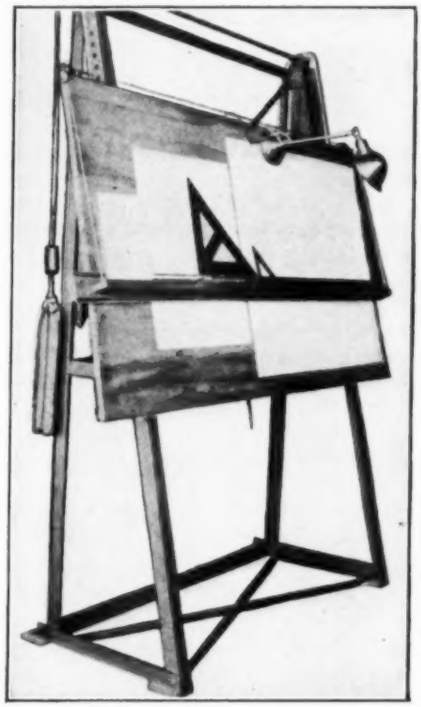
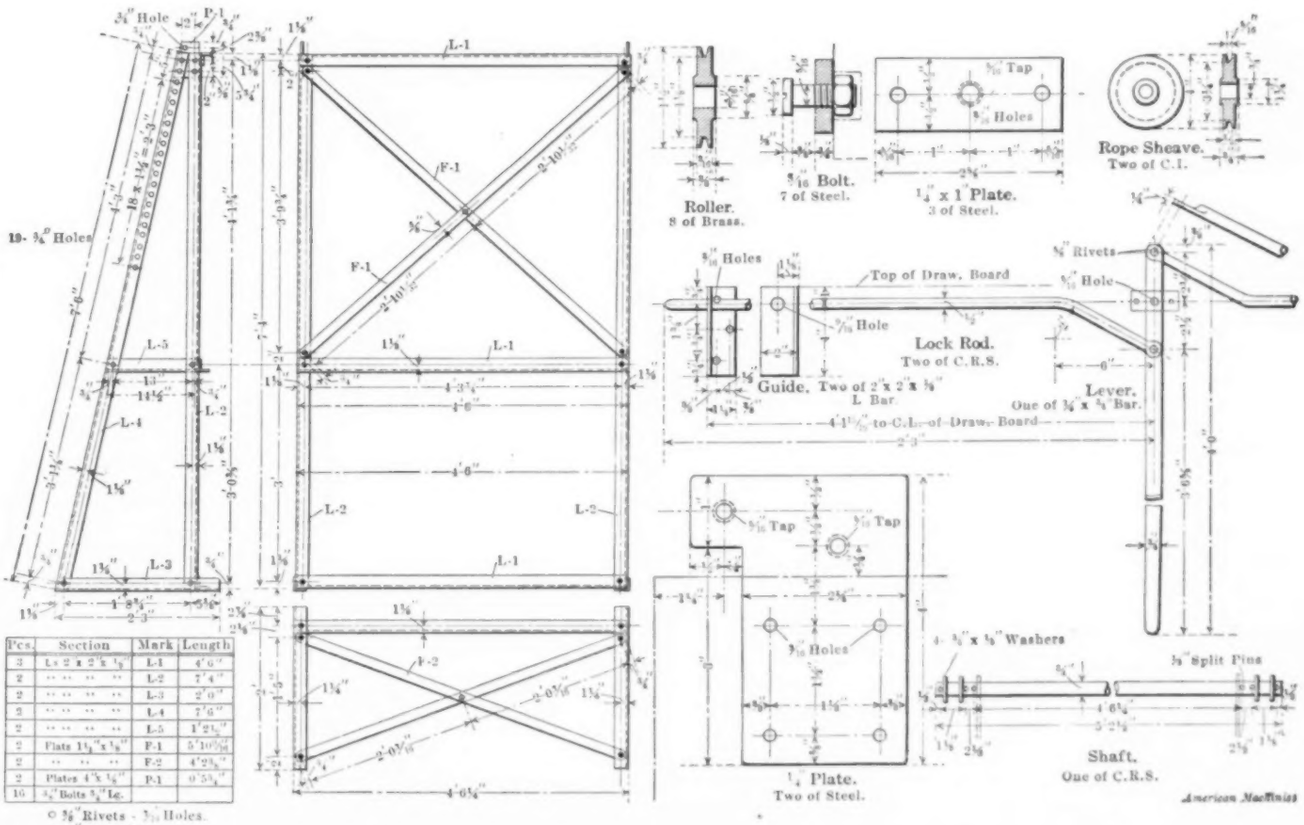


FIG. 1. FRONT VIEW UPRIGHT ANGLE IRON DRAWING-BOARD FRAME

FIG. 2. REAR VIEW SHOWING LOCK


Roller. 8 of Brass.
5/16" Bolt. 7 of Steel.
1/4" x 1" Plate. 3 of Steel.
Rope Sheave. Two of C.I.
Lock Rod. Two of C.R.S.
Guide. Two of 2" x 2" x 3/8" L Bar
Lever. One of 3/4" x 3/4" Bar.
1/4" Plate. Two of Steel.
Shaft. One of C.R.S.
American Machinist

Pcs.	Section	Mark	Length
3	Ls 2" x 2" x 1/4"	L-1	4'0"
2	" " " "	L-2	2'4"
2	" " " "	L-3	2'0"
2	" " " "	L-4	7'6"
2	" " " "	L-5	1'2½"
2	Flats 1½" x ⅛"	F-1	5'10⅞"
2	" " " "	F-2	4'2⅜"
2	Plates 4" x ⅛"	P-1	0'5¾"
16	¾" Bolts 5¾" Lg.		

○ ⅜" Rivets - 7/16 Holes.
● 7/16" Open Holes.

FIG. 3. DETAILS OF UPRIGHT DRAWING-BOARD FRAME AND FIXTURES

board, which I recently designed and had made for my own use. Having found this board both efficient and convenient, I thought it might be well to have it published for the benefit of those of your readers who, like myself, prefer the upright board and care to profit by the experiences of one who has been working at them for several years.

The frame is made up of angle bars and flats, the dimensions being given in the accompanying drawings. The two side frames are riveted together, while the horizontal connections and diagonals are bolted for the sake of easy transportation.

The drawing board proper is made of well seasoned white pine about ⅞ inch thick. It is 3 feet 6 inches wide and 6 feet long; allowing to lay out large drawings. The square is 4 inches wide, ⅜ inch thick and beveled on both sides. It is made up of five strips of two kinds of wood to prevent it from getting out of true. Another strip ¾ inch by 2 inches is screwed to the square at right angles. This offers a convenient place for depositing tools, pencils, etc., and also gives a possibility of straightening the square, in case it should get warped, which can hardly be prevented. By loosening the screws which connect the strip to the square and inserting fillers, the square can be given almost any form.

The fixtures are shown on the second drawing, their respective positions at the board can be easily seen in the cuts. The drawing board as well as the square are balanced by counterweights, for the drawing board, four window-sash weights and cotton rope are used, while the square is balanced by two pieces of round bar 1½ inches diameter and 3 inches long, drilled through the center and supported by picture wire. Light picture wire is also used for the parallel motion of the square, both ends of the wire being clamped to the wooden guide block at the right end of the square. The arrangement of the locking device holding the board in its vertical position can be clearly seen in the halftone of the rear view. By moving the handle extending from under the board, to the right the lock rods are disengaged and the board can slide up or down to the required position, where it can be held by pushing the handle back.

Personally, I find it necessary to change the incline of the board only when tracing and doing very little of this work I did not provide elaborate means for setting it at different angles. Those, however, who want to incorporate this feature, will find little difficulty in providing proper means for this end. The upper ends of the strips which bear against the frame are rounded off so that the board can be swung around the lock bars to almost a horizontal position. Whenever I have to do any tracing I simply swing the board out to the desired position and then put my office stool under the lower edge of the board. This, I will admit, is a very primitive way, yet it has been satisfactory. It remains to be said that, even without fastening the frame to the floor with screws, which might be done, the board is steadied well enough by its own weight.

I should be glad if these lines would help any of your readers in procuring the rest and comfort that the upright board gives to the draftsman in any case, especially, however, when laying out large drawings.

Milwaukee, Wis. F. A. L.

Simplified Formulas for Bevel Gears at Any Angle

Many formulas have heretofore been published for determining the angles and

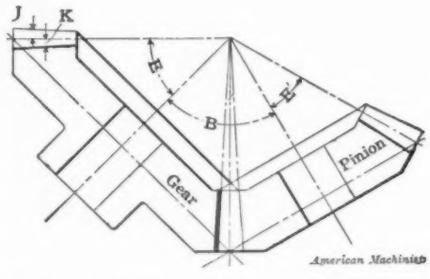


FIG. 1. BEVEL GEARS WITH AXES LESS THAN 90 DEGREES

dimensions of bevel gears not at right angles, all of which are more or less confusing. It is simply a matter of finding the center angles; all other angles and dimensions are obtained as for ordinary bevel gears at right angles, each gear being figured separately. This also applies to the use of tables, the table being

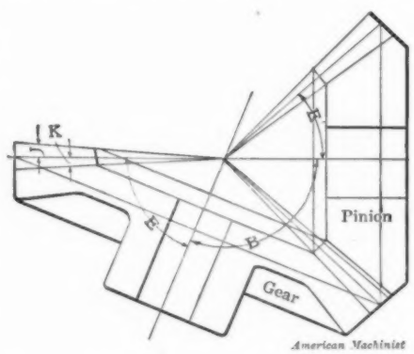


FIG. 2. BEVEL GEARS WITH AXES GREATER THAN 90 DEGREES

entered for each gear separately, according to its center angle and independent of its mate.

When the axes are not at right angles there are four other combinations; axes less than 90 degrees as per Fig. 1; axes greater than 90 degrees, Fig. 2; crown bevel gears, Fig. 3 and internal bevel gears. The center angles for these gears are found as follows:

N = Number of teeth in gear.
N' = Number of teeth in pinion.

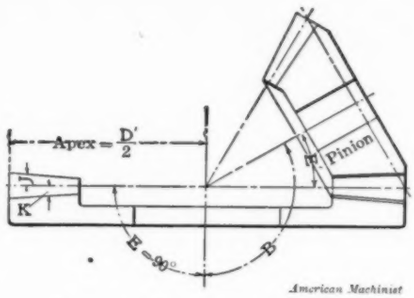


FIG. 3. CROWN BEVEL GEAR

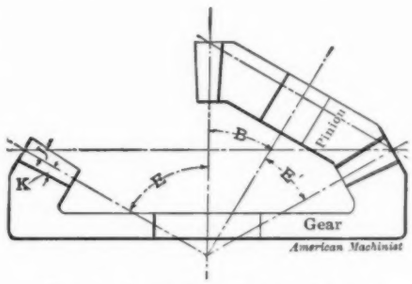


FIG. 4. INTERNAL BEVEL GEARS

Axes less than 90 degrees, Fig. 1.

$$Tan.\, E = \frac{sine\ \beta}{\frac{N}{N'} + cos.\ \beta}.$$

$$E' = \beta - E.$$

Axes greater than 90 degrees, Fig. 2.

$$Tan.\, E = \frac{sine\ (180 - \beta)}{\frac{N}{N'} - cos.\ (180 - \beta)}.$$

$$E' = \beta - E.$$

Crown bevel gears, Fig. 3.

$$E = 90°.$$

$$E' = \beta - 90.$$

Internal bevel gears, Fig. 4.

$$Tan.\, E = \frac{sine\ \beta}{sine\ \beta - \frac{N'}{N}}.$$

$$E' = E - \beta.$$

New York. CHARLES H. LOGUE.

Tapping Large Pipe Flanges in the Lathe

Many small shops do not have a full supply of pipe taps. The boss of one of these small shops had a number of flanges from 2½ to 10 inches to tap. There were not enough of each size to warrant the purchase of taps, and he had no lathe with a taper attachment. He made a stout holder for a 1-inch U. S. S. tap, secured the tap in it on the lathe, at the correct angle, and using the tap as a chaser, with the correct change gears, tapped (or chased) all the flanges satisfactorily.

Discussion of the Previous Question

Letters from Our Readers Showing how many Men of many Minds Look upon Various Subjects Opened up in previous Numbers

Dies for Forming Tools

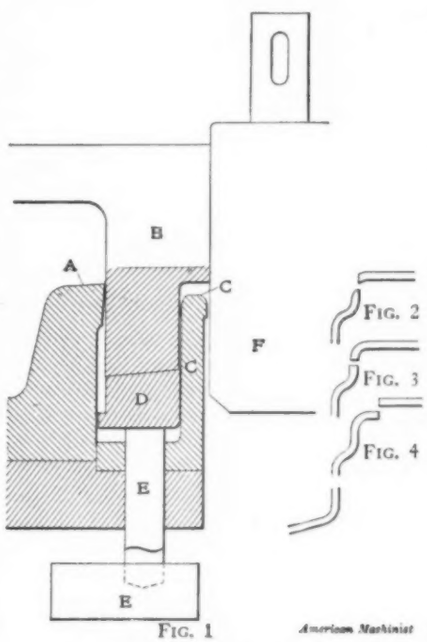
If any further suggestions are still in order on Mr. Card's questions at page 839, Volume 32, Part 2, re seamless drawn tubes shown there, I wish to offer mine. Evidently Mr. Card has a set of dies in operation on this article, but wishes to improve them, so I assume that he requires no minute details as to how the article should be made. Therefore, I am only going to add a little to what has been said and request Mr. Card, at some future time to write up the dies that gave him satisfaction, as part payment for our interest in the matter.

If a double-action press is available, the dies shown in the half section herewith, Fig. 1, will give good results; I have made and used similar to it. It is a cut-and-draw and redraw type, the cut-and-draw part working on the single action principle, and the second or inside punch redrawing the cup by turning it inside out. The work can be drawn straight down and pushed through or a flange left on and the work pushed up by an ejector and left on the die.

A is the cut edge; *B* is the cutting punch and also acts as the drawing die; *C* is the die center, or center block over which the metal is drawn; *D* is the pressure ring, pressure being applied by a hollow rubber barrel (not shown) under the pin-plate and pins *E*. The die-center *C* is hollow, permitting the second punch or plunger *F* to draw the metal down inside of it.

The action of the die is as follows: *A* and *B* cut the blank, which is drawn between the faces of *B* and *D* over *C*; after the edge of the blank enters punch *B*, *B* dwells and *F* begins its stroke, drawing the metal over the two rounded edges of *C*. On the return of *F* the work is stripped by the sharp inside edge of *C* and falls through the die. If a flanged shell is wanted the punch *F* travels only the required distance and returning, strips the shell from itself by means of the inside face of *B* and a spring pad inside of *C* brings the work to the surface of the dies.

Points to notice closely in this type of die are: Make the faces of *B* and *D* at an angle of 10 degrees to permit upsetting when dull or accidentally sheared, and fit these faces well. The outside wire-edge or rounding of *C* should be larger than the inside wire-edge; if they are both the same radius the outer edge delivers more stock than the inner edge can dispose of and wrinkles from between them that are carried down in the work and soon wear ripples in the die. Fit the inside face of *B* to *C* so that these surfaces can hold the metal when the otherwise uncontrolled edge is passing between them; this is not necessary when reducing the body, only for the edge. And supply proper air-vents. It will be noticed that the face of punch *F* is beveled. This should be done on taper redrawn work as it furnishes an immediate bearing for the pressure rings and assists in disposing of a surplus of metal at the small end, especially preventing wrinkles in thin metal. In single dies the die center should be beveled.



DIES FOR FORMING TUBES

As to the question of punching or rotary trimming the small end of the tube, I offer the following: With the method in Fig. 2, termed "punching the wall" of the stock, the maintenance is expensive and even when the work is well done, a very sharp edge is presented, due to the round edge of the work. "Body trimming," Fig. 3, by the rotary method is a slower process and more stock is used. In Fig. 4 the end is punched about ¼ inch smaller than the diameter of the end and the stock turned up; "stretched" it is called. There is a saving of stock here, the dies are easily kept up and the edge of the article is left square and clean cut. The same sketch shows a flange left on the large end of the tube so that it can be trimmed in a die at the same time that the end is punched. The flange can be drawn up into the larger diameter at the same time the small end is stretched. When these dies are fitted with slides to place each shell properly, as they should be, we usually pay 10 cents per thousand for each press operation, except cutting, which may go to 15 cents.

Quincy, Ill. W. H. SIRIUS.

Bushings—A Driving Fit

On page 446 is an article on the effect of heat on a bushing which is driven too tightly into a wheel hub. In that article the argument is based upon the assumption that when the bushing gets hot, it does not have much chance to expand outward on account of the hub, so it must expand inward, binding the shaft. It is also pointed out that an additional crushing tendency is produced by the heating of the hub itself, which, according to the article, "will tend to resume its original dimensions," which refers to the diameter of the hole before the bushing was driven in.

It has been my impression that to put a crank disk on a shaft, it is sometimes heated in order to expand the hole in the center, that it may slip over the end of the shaft. If, according to the article in question, the hole gets smaller when the piece is heated, all our friends who are shrinking crank disks in place, are laboring under a mistaken idea that the disk goes on easier when hot. Is it not possible that the trouble with the hot bearing is due to the fact that the shaft becomes larger with the heat and therefore grips the bushing in the wheel?

New York City. R. S. BAYARD.

Reducing Size of Hole by Heat Treatment

What seems to me, by actual experiment, the best way to reduce the size of a hole in ring-gage bushings, etc., that have been bored or reamed too large, is by cooling the outside metal first, by having a board or any convenient flat surface in the water tank. It should be below the surface about half the thickness of the wall of the bushing to be shrunk. Heat the bushing, then holding it on a bent piece of wire, roll it on the board held in the water until cool. This done repeatedly will close a hole

uniformly any reasonable amount according to the size and shape of the bushing or ring. For instance, 1 inch outside, ½-inch hole would close about 0.005 inch in one treatment; after shrinking, harden in usual way.

This method, although not entirely new, will save a large number of bushings, that are machined and partly lapped, from going to the scrap box.

Mr. Chapman does not mention in his article on page 116, about what size bushing would close 0.05 inch. If it is possible it would probably take about the same length of time as to make a new one.

Providence, R. I. D. W. M.

Calculation of Power Loss in Slipping Belts

It is said that figures do not prevaricate. That is as far as I dare to go with this quotation. It is always pleasant to have mathematics to prove what one believes, but it is well to temper one's mathematics with common sense.

On page 495, an article on the subject of slipping belts by A. L. Campbell, uses several hundred words to get a mathematical expression for the power lost by a slipping belt. To start with, he assumes that the tension on the slack side of the belt is 135 pounds, and on the tight side 300 pounds, making a net pull of 165 pounds, which, at the belt speed given, namely 2000 ft. per minute, will transmit 10 horsepower. The total belt slip is also assumed to be 10 per cent., referred to the belt speed.

Now, after calculating the unit pressure around the arc of contact of each pulley, Mr. Campbell assumes the coefficient of friction of 0.2, and calculates that the "grip" of the belt on one of the pulleys is 123 pounds, and on the other pulley is 154 pounds. If it requires 165 pounds of pull in the belt to transmit the 10 horsepower, which end of the belt is actually receiving the 10 horsepower? If neither end is receiving it, from what source comes the extra pull required to make up the full 165 pounds in the middle of the belt? The pull on each pulley must be alike, and the same as at the middle of the belt. According to the article in question, and the mathematics therein, this does not come from the force exerted by the contact of the belt upon the surfaces of either pulley.

It seems to me a little more reasonable to assume that the actual belt pull of 165 pounds is slipping over the surface of each pulley at a speed equal to the difference in the speed between the belt and the pulley. As the original assumption was that the slip on the motor pulley amounted to 120 feet per minute, why would not the loss be equal to 165 pounds multiplied by 120 feet, or 19,800 foot-pounds per minute? In the case of the other pulley where the slip is assumed to be 80 feet per minute, why is not the loss equal to 165 pounds multiplied by 80 feet, or 13,200 foot-pounds per minute? The sum of these two amounts to 33,000 foot-pounds per minute, or one horsepower lost. As the slip was calculated at 10 per cent. referred to the *belt* speed, is it not reasonable that the power loss should be 1 horsepower, or 10 per cent. referred to the power carried by the belt?

This seems very good mathematics and common sense to me, although, of course, I may be wrong. As a matter of fact, the probable trouble with Mr. Campbell's argument is that he has taken the wrong coefficient of friction between leather and iron, to suit the slip assumed. If he had made this coefficient of friction just right, to suit the other assumptions which he has made, or if he had made the slip correct to suit the coefficient of friction and the unit pressure, the actual loss would have figured up to one horsepower, just as I have made it, instead of ⅞ horsepower, as he has it. Truly, a little mathematics is a dangerous thing.

New York City. S. R. BENEDICT.

Truing a Crank Pin Hole

In answer to H. Maplethorpe's query at page 126, Volume 33, concerning his crank-disk trouble, I would suggest that he abandon the shrinking process for that of cold pressing.

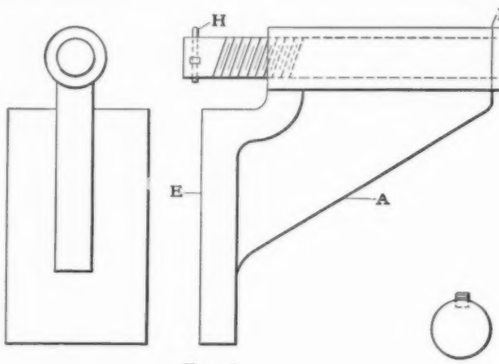


FIG. 1

BORING RIG FOR CRANK-PIN HOLE

It is doubtless the unequal contraction of the irregular masses of metal in the disk that throws the parts out of line. I should also advise a few more thousandths for a fit if the shaft is above 1½ inches in diameter. There are convenient tables compiled that give the allowances for fits with various sizes of shafts.

If there is no suitable press or puller-bars available, shrinking will have to be resorted to, but it will then be necessary to true the pin-hole with the shaft after the parts have cooled. An efficient little rig that I have found very satisfactory for this purpose is made as follows:

Referring to Fig. 1, *A* is a cast-iron bracket, carrying the threaded boring bar *C*. *D* is a crank for driving the bar. The bracket is faced off square on the surface *E* and the hole for the bar is bored at right angles to this surface. The end of the bar-bearing at *F* is also faced off square with the bore. The bar is threaded with a comparatively fine thread, say a 32 pitch and works in the removable nut *G*. The nut is put on with suitable screws against the faced end of bearing. To provide a suitable guide bearing surface on the bar, the thread is cut shallow, leaving the corners of the thread smooth and flat.

To use the device, the bracket is clamped against the face of the crank-disk and the bar trued up with the shaft, irrespective of the face of the disk. This is done by placing a long, snugly fitting bar in the bearing of the bracket, letting it project along the shaft through the crank-pin hole, far enough to aline the two by calipering, suitable shims being placed between the bottom of the bracket and the disk to give the desired alinement. The test bar is then replaced with the boring bar, the tool *H* adjusted to take a light cut, and run through.

The power required is very slight and with ordinary care a hole true with the shaft can be bored.

While on the subject of emergency tools I would like to mention an extemporaneous keyseater that saved us a lot of trouble.

We had a quantity of small gears to

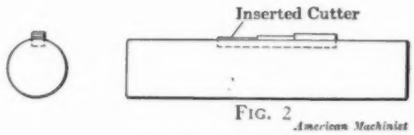


FIG. 2 *American Machinist*

SMALL KEYWAY BROACH

make, when the question of keyseating them came up. The bore was about ⅝-inch, and we had nothing on the regular machine that would handle so small a bore. After a little cogitation a broach was rigged up that did the job in record time.

The tool consisted of a short piece of steel turned to a nice, sliding fit in the bore of the gear. In this piece of shaft, a stepped cutter was mortised, the cutter being given three steps, so that when forced through, each step added 1/32 inch to the depth of keyway. A

vise was used for a ram, a piece with a suitable hole in it being placed between the vise jaw and work, to allow the broach to come through.

St. Paul, Minn. GEO. MARSHALL.

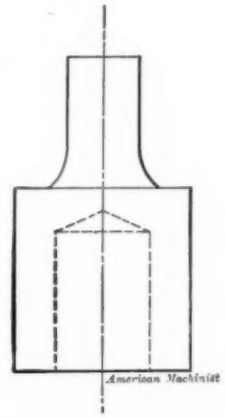
Making the Square Hole in Socket Wrenches Cheaply

W. W. G's. article on page 171, describing a cheap square-hole drilling fixture for chuck and socket wrenches calls to mind a similar experience of my own.

His method may make a little cleaner hole at the bottom than the one I am about to describe but I am afraid it would be too slow where thousands of such wrenches were made yearly. Then, too, his fixture entails quite an initial expense and the form is subject to wear.

Several years ago, while with a firm which made a specialty of all kinds of drop forgings, including wrenches, they received a large order for chuck wrenches very much like the ones described by W. W. G. Here is how the job was done to the satisfaction of all parties concerned.

Bar stock was run through the automatic screw machine, the head end formed and drilled somewhat deeper than



WRENCH END TO BE WELDED TO HANDLE

the depth of the square or hex required and then cut off just above the socket portion, as in the figure. The diameter of the drilled hole was equal to the width of the square or hex required.

These ends next passed to a Ferracute press fitted with a square or hex punch and a simple fixture on the bolster to hold the work upright and central, one stroke of the press finishing the hole, the stock from the corners going into the extra depth of the drilled hole.

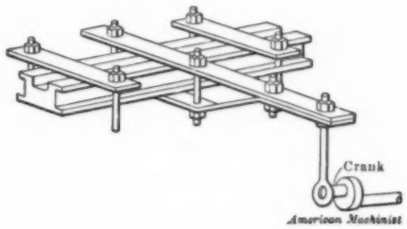
Provision must be made for the escape of the air either through the punch or in using a slightly larger drill than the square required. A slight air compression will do no harm; in fact it will aid in stripping the work from the punch.

The ends next passed to the electric welding machine where the style of handle required was welded on. This saved turning down large stock.

Brooklyn, N. Y. H. TERHUNE.

A Machine for Seasoning Castings

In the AMERICAN MACHINIST, under Editorial Correspondence—"Making Star Lathes," on page 100, a method of seasoning lathe-bed castings is mentioned.



MACHINE FOR SEASONING CASTINGS

This may be better than no seasoning, but I think better results might be obtained if the bed was hitched up to a jacking machine as per sketch, and left to the mercies of this machine for a certain length of time, the longer the better. This process would yank out all the internal strains, after which a fine finishing cut can be taken.

The sketch shows the frame rigidly bolted down on each end; with a beam bolted across its center for conveying a twisting motion thereto by means of a short crank or other means.

Chicago, Ill. M. JACKER.

Heat Treatment of Steel

Concerning Mr. Bain's experience in mixing the different tool steels and their heat treatment, page 324, I wish to suggest that he at once find out who is mistaken in the kind of steel used. I think it will be found that the one who made a mistake was the salesman, who probably would not know steel from finished iron if the labels were removed and evidently there was no label on the "piece of good carbon stock" (in the words of Mr. Bain) or the toolmaker would have seen it

Probably neither Mr. Bain nor his friend has ever heard of the spark test to determine the quality and kind of steel. Every kind of steel has its characteristic spark according to its ingredients, when ground on an emery wheel. Iron and soft steels have a dead-white spark, carbon steels a white explosive spark and the proportion of dead sparks shows its quality or temper. High-speed steels show various dull-red sparks, some dead and some explosive but in a greatly reduced proportion. Intra steel shows the characteristics of both carbon and alloy steels. With experience one can distinguish the sparks of manganese, tungsten, chromium and molybdenum and thus distinguish the various kinds of high-speed steel. So the thing to do is to spark test the tool. If it shows a carbon-steel spark and does work superior to high-speed steel where common steel will not, then put it in the safe—it will be needed for analysis and tests.

But carbon steel will not stand high-speed heat treatment. The elements when properly heated and quenched at the recalescent point or point of transformation form martensite, the hardest constituent known to carbon steel; heating higher forms austenite which is softer and much coarser, and has lost its good cutting qualities, crumbling where a properly treated tool stands up. This can easily be proved—try it.

Quincy, Ill. W. H. SIRIUS.

Dry versus Wet Grinding

The paper on dry versus wet grinding interests me. In reading it through, however, it appears that the editors' questions are misunderstood by some of the firms approached relative to grinding drills. If I am correct in my conclusions, the editors intended to ask for information relative to the merits or demerits of dry versus wet grinding when drills or other cutting tools are being resharpened on the ordinary abrasive wheels, known by the general term "emery wheels." Some of the replies received evidently refer to the commercial grinding incident to manufacturing drills, and are not applicable to the discussion.

As most of our modern machine shops are using abrasive wheels for all resharpening of cutting tools, it appeals to me that a fair discussion of the merits of wet versus dry grinding with reference to cutting tools is a timely one. The old grindstone needed a lubricant to soften the surface of the stone and release the fine abrasive particles, and prevent glazing. Use of water on an emery grinder is for the sole purpose of keeping the cutting edges cool while the tool is being resharpened. Using the older emery wheels, this use of a lubricant may have been necessary, but with the advance in abrasive wheel making and the advent of the new artificial abrasives, it would appear as if a proper selection of wheel made it unnecessary to use a lubricant. Certainly when the cutting edges of the tool are not much dulled the amount of stock to be removed in resharpening the tool does not render it necessary to overheat the cutting edges if a free-cutting, non-glazing wheel is used. It is to be hoped that your readers will give expression to their experiences relative to the resharpening of cutting tools on abrasive wheels.

Boston, Mass. CASE.

A Plea for the Untrained Worker

I notice in the AMERICAN MACHINIST the article by Entropy on page 348, "A Plea for the Untrained Worker." In it he states views commonly held by the American-born mechanic about European-born men; whether they be Italians or Germans, or Hungarians or Poles. They are regarded an inferior to the native-born American. Entropy is really trying to improve their condition, at least he is suggesting a way to do it, but his assumption that those Europeans are scrap is wrong. I am inclined to think they are really superior to the native born, because the climate of Europe is better than the climate here. The fact that those Europeans we meet here are poorer in dress, in manner, in education is no proof that they are inferior.

I was born in Europe and came from a small country town, in a country the name of which inspires usually a flow of sarcasm from the native-born American. The country is Hungary, but I am of German descent. We are all mechanics in my home town, but not machine-shop mechanics. I came here when I was 18 years of age and at that time I was not able to read, write or speak English. Now I am 33 years of age.

Now these foreigners have an education which is about the same as those born here get in public school, but of course, when they come here they are lost. They cannot make themselves understood, and consequently the native thinks they are inferior in education to himself. That is not so. Many of them have a better education than the native, they certainly are far in advance in hospitality toward strangers than any American born. I have seen thus far, the thing to do is to get to work and say these foreigners are of good stock; they are able to take up any line of work after a certain amount of training.

There is nothing hard about machine-shop work or any kind of work. Anyone can learn provided he is given a fair show and a little lift over difficult places. But no one will ever make a good mechanic out of anyone by putting him on one machine, and one class of work. His senses become dulled. Gradually his natural ability goes from him. He may strive to change it by evening study, but it is all in vain. The only way to change him is to give him a show on all machines and all classes of work. This is for the interest of the employer as well as the employee. In fact, I am astonished that the employers should be so short-sighted as not to train their men.

The AMERICAN MACHINIST may voice sentiments in favor of schools, education may create technical high schools and trade schools, but it is all in vain. Let us have a change—an opportunity to learn the trade thoroughly and at the same time go to school evenings. I have been reading and studying since I came here, but it has done me no good. In vain have I gone to school, in vain have I taken all the magazines published. In fact, I am poorer today than I was when I came here, for a great deal of my hope is gone and I have never been able to save anything.

Chicago, Ill. ROMULUS.

Grinding in Gears

I have read the letter of F. C. Mason on page 1138, Volume 32, Part 2, with interest, and venture to make a few remarks upon a subject that has attracted a comparatively small amount of attention.

I served my apprenticeship with a firm of motor engineers and have vivid recollections of the early attempts at accurate gear production. No grinding-in process was used. The gears were left full, i.e., slightly over the correct theoretical dimensions and assembled in the gear box while soft. The shafts were then forcibly rotated, by means of a flat bar having a square hole to fit one of the shafts, and the high places filed down by hand.

However, it was found after case-hardening that there was no uniformity in the gears, some having shrunk and some expanded on account of the different qualities of two pieces of steel, even when cut from the same bar. Of course, it was then a case of selecting the "nearest" or best running pair of gears for any box and interchangeability although it figured in the catalog was practically a negative quantity. It is on account of these early experiences that I should like heartily to indorse Mr. Mason's recommendation with regard to the grinding of hardened gears on automatic machines.

Mr. Mason states that he has seen brass gears run in with emery and lard oil. I have seen steel ones treated in this fashion, in fact it is quite common practice, but I have never seen brass gears treated similarly. These are usually run in dry and the operation in this respect is equivalent to the turning of brass.

In some motor-car works it is customary to pass all gears by gage and only such gears as are tight in the gage are ground in (usually in emery and tallow). If the gears sound noisy when the vehicle is on the road under test, the gears are taken apart and touched up by oilstone.

Mr. Mason refers to the grinding of the ordinary wheel glass-cutter. The reason that the edge of the cutter is ground while the cutter itself is revolving is, I take it, due to the partial binding of the cutter either on the pivot, or against the inside faces of the cutter bar or shank. To this same reason may be attributed the fact that gears being run in grind each other away. The high spots on a pair of gears are not always facing each other and when not facing, the gears are tilted over slightly on their respective spindles and bind slightly.

I should like to see the question of machine grinding of gears in quantities discussed further by readers, as it is a subject which touches almost every branch of small engineering work.

Glasgow, Scotland. J. H. JOHNSON.

The Accelerating Cut on Crank Shapers

On page 214, Frank G. Hudson writes in regard to this question, and his reasoning sounds good to us. In fact, the writer sent an article on the very same subject to the AMERICAN MACHINIST, and same was published about November 1908, under the title of "What's the Matter with the Plain Crank Shaper?" in which practically the same claims were made as in Mr. Hudson's article, expressed somewhat differently.

We believe in the accelerating cut for more reasons than just the point brought out by Mr. Hudson, which was the matter of speed. We believe in it principally because it is a simpler construction, one shaper builder using three sliding surfaces to get a quick return and an even cutting speed. We bring out the fact in our catalog that we have the accelerating cut, as follows: "We obtain the natural quick return provided by motion of sliding block, the rigid construction and great power, with the accelerating cut, enables this shaper to take heavy cuts at fast speeds that double discount the trappy devices for quick return." And again, "The cut is accelerating, a higher average speed being possible than on an even cutting speed."

The real question to be decided is, how many round trips can the ram make on a given job, without overloading the machine, burning up the tool, or breaking out or otherwise spoiling the work.

A. M. WATCHER.

Queen City Machine Tool Company, Cincinnati, O.

Getting Chips Out of a Hole

If the hole you are boring is so nearly the size of your bar that the chips fall on the bottom of the hole and crowd the bar up, making it cut larger than it ought, then try this: Wind a piece of copper or brass wire in a spiral around the bar, right- or left-hand, according to which way the bar or the work turns, from the cutter to a point more than the full depth the bar will enter. This spiral will convey the chips along and keep the hole clear.

22-inch Self Contained Roll Grinding Machine

The halftones illustrate a new roll-grinding machine built by the Norton Grinding Company, Worcester, Mass. It is intended to grind rolls up to 22 inches diameter of body and to support these rolls on necks as large as 12 inches diameter. It is also adapted for grinding such rolls on centers when desired and the centers of the machine are made very large to provide for durable center bearings. The footstock spindle and the headstock stud are 4⅞ inches diameter and the centers themselves are 3½ inches diameter. The grinding wheel has a face 4 inches wide and a wheel 22 inches diameter is used when grinding 22-inch rolls. A 24-inch wheel may be used when necessary.

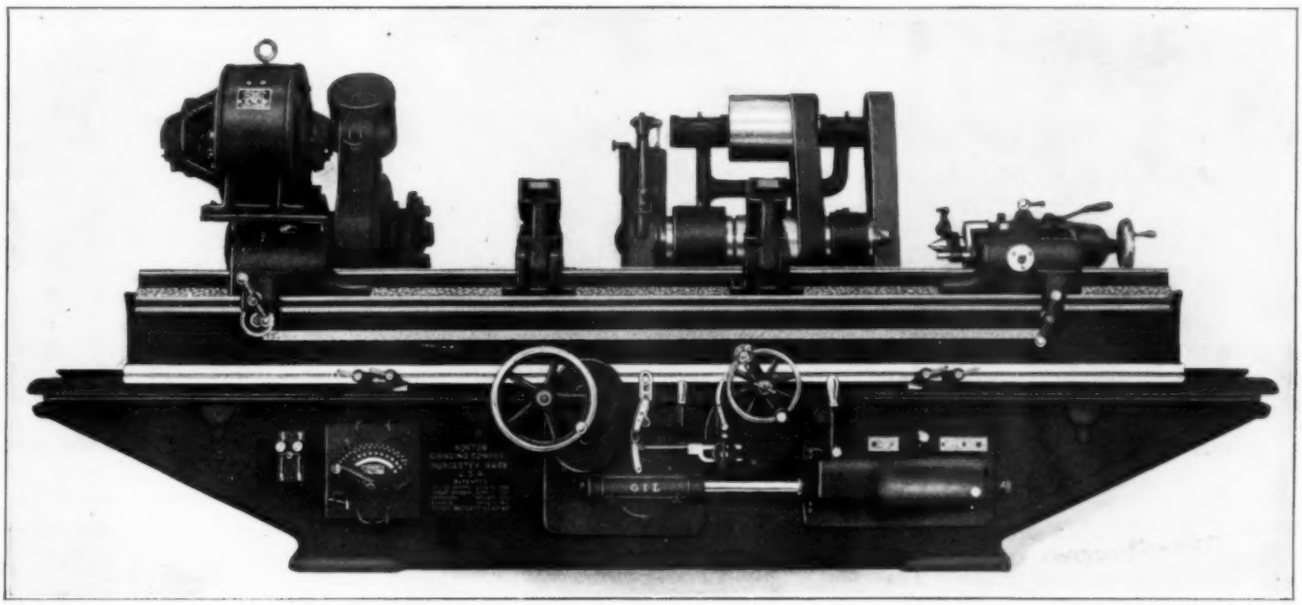


FIG. 1. FRONT VIEW 22-INCH SELF-CONTAINED PLAIN GRINDER

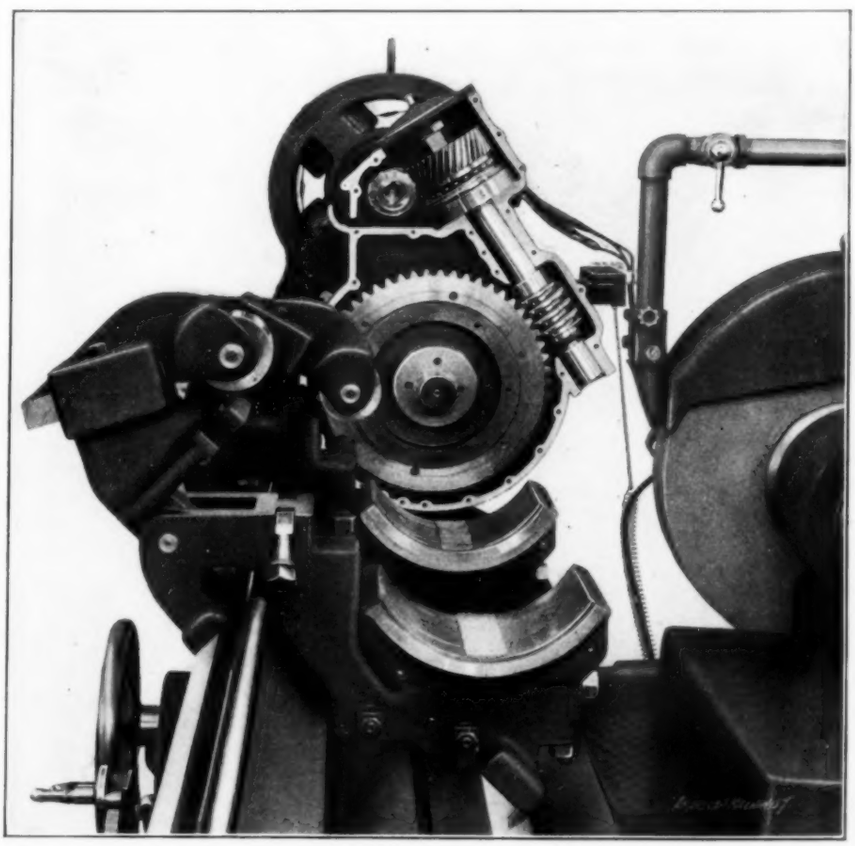


FIG. 2. END VIEW OF DRIVING GEARING SHOWING CONSTRUCTION OF JOURNALS

THE DRIVE

As illustrated in Figs. 1 and 3, the machine is motor driven and self contained. The grinding wheel is driven by a 15-horsepower motor shown on the floor in the rear view, Fig. 3. This motor also drives the pump and traverses the table. The work is revolved by a 5-horsepower motor mounted directly on the headstock as seen in the three views. The work has a very powerful drive made necessary by the fact that these heavy rolls revolve on their journals, thus requiring more power than when revolving on centers.

A floating device is applied to the work drive of the headstock so that any errors in alinement between the headstock axis and the roll axis are compensated for.

THE WORK SUPPORTS

The construction of the journals for supporting the rolls on their necks can be seen in the end view, Fig. 2. Bronze shoes of different radii are provided for different diameters of necks and these bronze bearings are provided with felt in a recess at the bottom for supplying constant lubrication. Adjustable steel rollers are provided to run in contact with the neck to prevent any possibility of the roll being forced from its true axis in the bronze bearings. The bronze bearings are

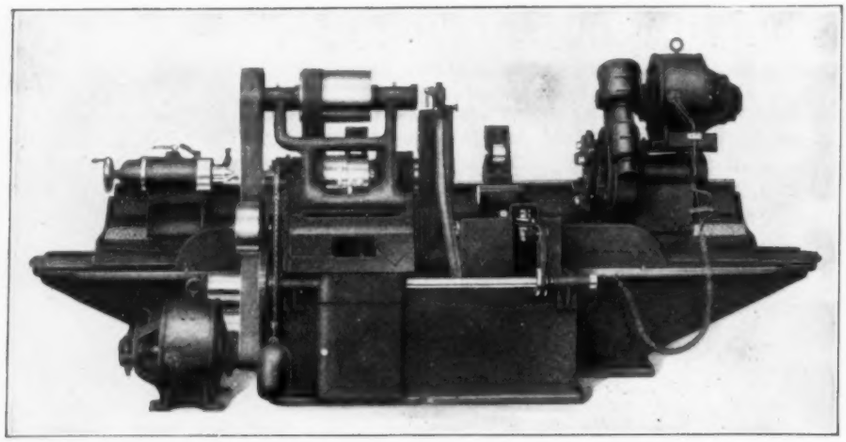


FIG. 3. REAR VIEW OF 22-INCH SELF-CONTAINED PLAIN GRINDER

necessarily much less than half the circumference of the roll neck because of slight variations in the diameters of the necks themselves. As will be seen in Fig. 2, the steel rollers can be turned back out of the way when lifting the roll from the machine or when placing it in position.

THE HEAD GEARING

The method of transmitting the power from the motor to the revolving work is also shown in Fig. 2 where the plate covering the gearing has been removed. The drive is very powerful, the 5-horsepower motor making 1700 revolutions while the worm-wheel revolves 10 revolutions per minute. A variable speed motor is used and as the machine is limited to heavy roll grinding the number of speed variations is consequently limited, the maximum number of revolutions of the work being 10 and the minimum 5 per minute.

Both the spiral pinion and the worm wheel run in oil and the thrust of the worm is taken by a large ball bearing which also runs in lubricant. The headstock is so geared to the rack on the front of the table that although heavy, with its motor it is easily moved by the operator along the ways. The footstock is geared to the rack for the same purpose. The variable speed control is seen at the front of the machine, also the knife switch. The mechanism for traversing the table is that regularly employed on the Norton grinding machine with which readers are familiar.

The weight of this machine is 18,500 pounds. As indicated in the foregoing description it is limited to roll grinding and to rolls from 12 to 22 inches diameter.

Duplex Double Reduction Worm Gear Drive

In the accompanying halftones there is illustrated an interesting worm-gear drive for driving two shafts from one motor, with a double reduction in each case. Referring to Fig. 1, it will be seen that on the shaft *A* there are two worms driving worm wheels in the casings *E E*. Upon the shafts of the latter worm wheels are two vertical worms driving another set of worm wheels in the casings *F F*. The power from this point is transmitted to shafts extending from *B* and *C*. The driving motor applies this power to the shaft *A*, through a flexible coupling and it will be seen that there is a flexible coupling also between the two worms upon this shaft. Shaft *A* has a speed of 700 revolutions per minute and the reduction in speed is in two steps, each of a ratio of 10 to 1, making a total speed reduction of 100 to 1. This, therefore, results in a speed of 7 revolutions per minute for each of the shafts *B* and *C*.

As to details; the worm wheels in the casings *E E* are 19 inches in diameter; have 40 teeth with 1½-inch pitch. The worms driving these wheels are 5.974 inches in diameter; have a 6-inch lead and are made with four threads. The pressure on the pitch line of the worm wheels varies from 750 to 1000 pounds. In the casings *F F*, the worm wheels are 24.9 inches diameter; have 40 teeth, 2-inch pitch and the worms are 10 inches diameter, with an 8-inch lead and 4 threads.

Upon the shaft *A*, the thrust is taken up by ball bearings in which there are 28 balls ⅝ inch diameter. Owing to the

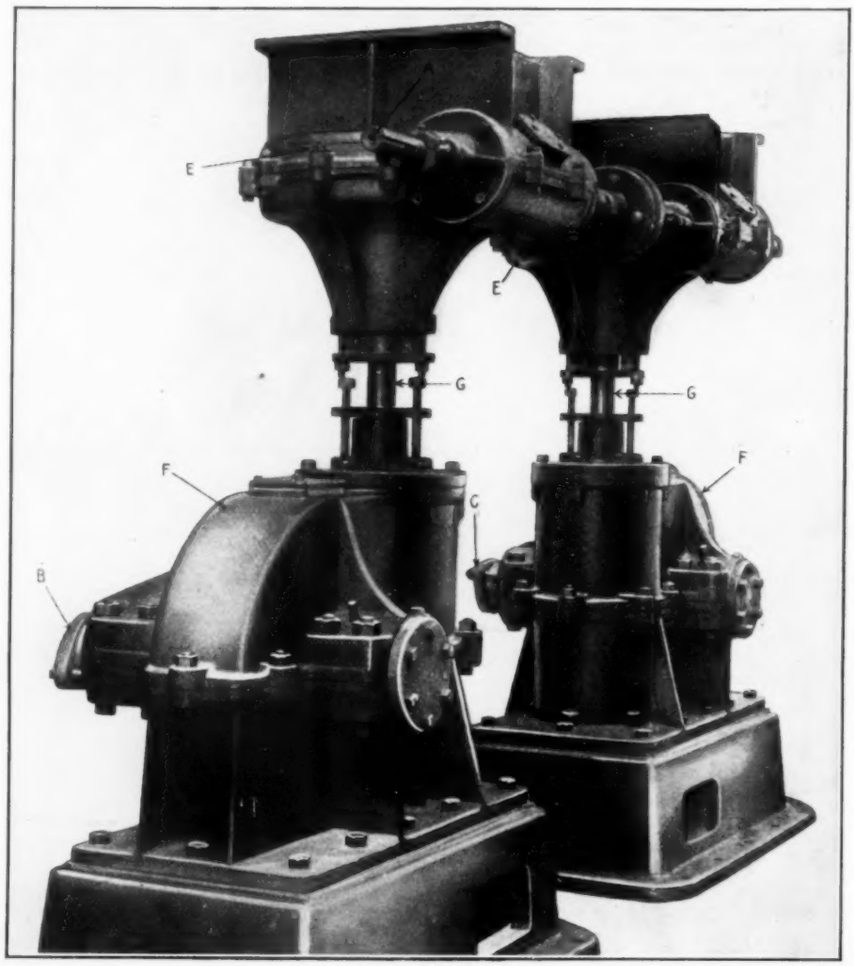


FIG. 1. DUPLEX DOUBLE-REDUCTION WORM-GEAR DRIVE

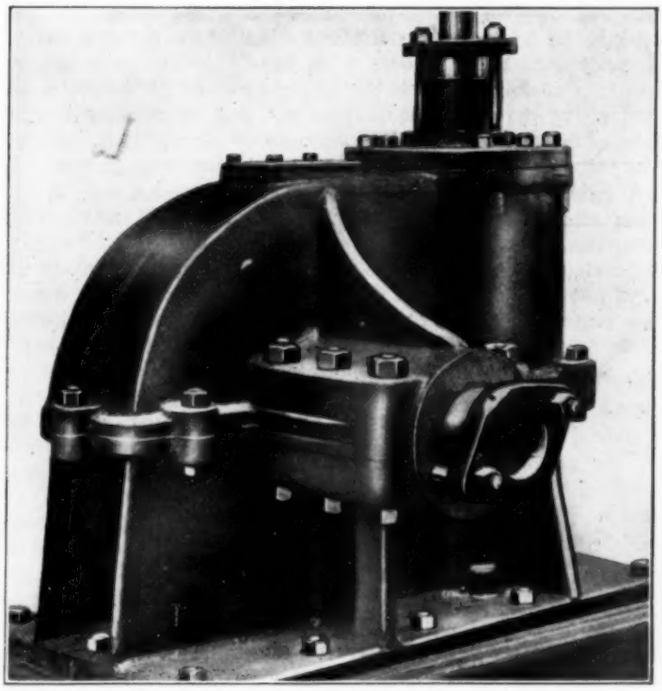


FIG. 2. ARRANGEMENT OF CASING

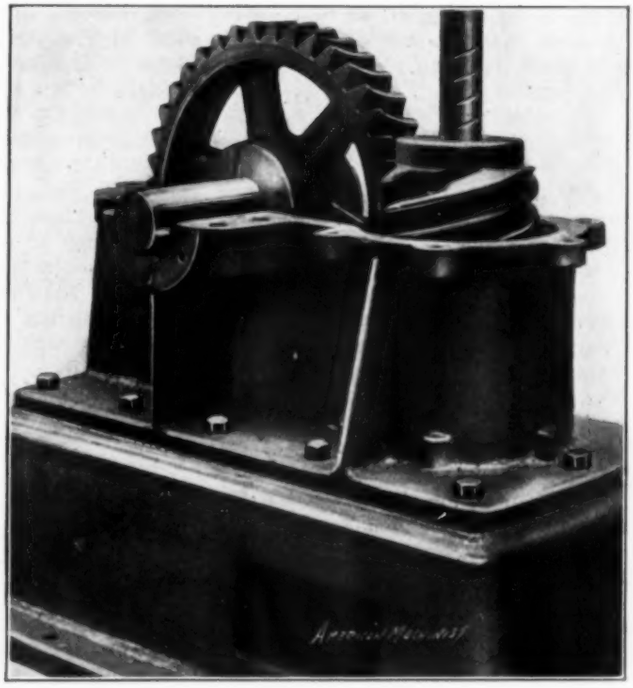


FIG. 3. THE GEARING

fact that the shafts *G* run at slow speed and carry a heavy thrust load, this thrust is taken up by roller bearings ⅞ inch diameter. All of the worms and worm wheels are made of steel.

As to power delivered on the shafts *B* and *C;* the pull at 12 inches radius is between 6000 and 8000 pounds, corresponding, at a speed of 7 revolutions per minute, to from 4 to 5½ horsepower. At this very slow speed, it will be appreciated that the thrusts and pressures produced are very considerable. However, it is said that this machinery is operating continuously, 24 hours a day, in a satisfactory manner.

This device is a product of Morse, Williams & Co., of Philadelphia, Penn.

A Simple Arithmetical Proof by Casting out the Nines

An old method of proving multiplication by the process of casting out the nines is one which is so handy that a wider knowledge of it cannot fail to be useful to the many persons who, although they have heard of the method, are not familiar with its working.

This process of proving an arithmetical problem is to add up the digits of the numbers involved, subtracting from each of these sums the nearest smaller multiple of nine and treating the remainders in the same way (that is, multiplying, dividing, adding or subtracting, as the case may be), as in the main problem. This gives an answer which is the same as will be obtained by adding the digits of the answer to the problem and subtracting therefrom the nearest smaller multiple of nine. In the process of casting out the nines, the operation of continuously adding the digits is performed, the actual casting out of the nines and multiples, resulting simply in reducing the size of the figures handled and possibly making it a little quicker.

In explaining a particular example, the process of continuous addition of the digits, being more easily demonstrated, will be best for explanation. For example, take the multiplication of the two numbers, 2854 and 3271. This is set down as follows:

2,854	sum = 19	= 10	= 1
3,271	sum = 13	=	4
2,854			4
199,78			
570,8			
8,562			
9,335,434	sum = 31	=	4

It will be seen in the above that the addition of the digits of the multiplicand is 19. Adding these digits, that is, the 9 and the 1, we have 10. Adding these digits, that is, the 1 and the 0, we have 1 for the final answer. Now, adding the digits of the multiplier, we have 13. Again, adding these two figures, that is, the 3 and the 1, we have 4 as a final answer. As the main problem was one of multiplication, we now multiply the figure 1 obtained from the multiplicand, by the figure 4, obtained from the multiplier, and we have an answer of 4. Adding the digits in the answer to the problem, we have 31. Again, adding these two, that is, the 3 and the 1, we have 4. It will be noticed that this 4 corresponds with the 4 obtained by multiplying the two numbers obtained by the continuous addition of the digits of the multiplicand and of the multiplier. The fact that the numbers obtained in this way are alike, proves either that the multiplication of the main numbers of the problem has been correct or that a mistake of 9 has been made. This mistake of 9 is the only possible mistake that could be made in the process, without its being detected. It is impossible to detect a mistake of 9, except by going over the entire problem again; but the chances of making a mistake of 9 may be considered small enough to guarantee the correctness of the problem.

If this proof were to be obtained by the process of casting out the nines, we would proceed as follows: Examining the digits of the multiplicand, we find upon inspection that the digits 5 and 4 added together make 9; therefore these two may be cancelled. The addition of the two remaining digits; that is, the 8 and the 2 make 10, and the nearest multiple of 9 to this is 9 itself, which subtracted from 10, gives the remainder of 1, as was obtained by the continuous addition of the digits, as above. Apply-

ing this to the multiplier, we have, upon inspection, that the sum of the 7 and the 2 make 9, leaving 3 and 1 to be added together, making 4, which was already obtained by the previous process. Applying this same method of casting out the nines to the answer to the problem, we have immediately upon inspection, to cast out the figures 9, 5 and 4, leaving the figures 4, 3, 3, and 3 to be added together, making a sum of 13. Subtracting the nearest smaller multiple of 9, that is 9 itself, we have a remainder of 4, as by the previous method, again proving the problem. If quick inspection of the figures shows a number of them which, combined together, make a multiple of 9, it is just as well to cancel these out as soon as discovered and to use the process of continuous adding for the rest of the digits; thus combining the two methods and perhaps obtaining the easiest and quickest solution.

As already intimated, this process of proving arithmetical problems may be applied to operations other than multiplication; in fact, it is good for addition, subtraction and division, as well, although in each case the same process must be gone through with the figures obtained by continuous addition, as is gone through in the obtaining of the answer to the main problem. For instance, if the problem is addition, we *add* all of the results obtained, by continuous addition of the digits, giving an answer which is the same as the continuous sum of the digits of the answer of the problem. For subtraction, the continuous sums of the digits would be *subtracted* from each other, and for division, the continuous sums of the digits would be *divided*. In the latter case it is usually easier to multiply the sum of the digits of the quotient and of the divisor, giving the continuous sum of the digits of the dividend.

As an example of the proof of a problem in division, let us divide 9,335,446 by 2854. These are the same numbers as were applied above, except that 12 has been added to the dividend, in order to make a remainder, to show how this will be handled. The performance of this problem would be as follows:

```
                3271  sum = 13 = 4
2854 ) 9335446  sum = 34 = 7
Sum = 19 = 10 = 1
       8562                  4 × 1 = 4
       ----                        3
       7734                        -
       5708                        7
       ----
       20264
       19978
       -----
        2866
        2854
        ----
          12  sum = 3
```

As will be seen, the sum of the digits of the divisor is 19. The sum of the 9 and the 1 is 10, and the sum of the 1 and the 0 is 1. Adding the digits of the quotient we have 13. Adding the 3 and the 1 we have 4. Adding the digits of the dividend we have 34. Adding the 3 and the 4, we have 7. Adding the digits of the remainder, we have 2 and 1, equals 3. Now, the multiplication of the quotient by the diviser, if the division is even, should be equal to the dividend. If the division is not even, the remainder must be added to the product of the quotient and the divisor to get the dividend. This is the problem which we have in hand. It has been shown that the continuous sum of the digits of the quotient is 4, and the continuous sum of the digits of the divisor is 1. Multiplying 4 by 1, we have 4 as an answer. Adding to this the continuous sum of the remainder, or 3, we have 7, and it will be seen that this 7 corresponds to the 7 obtained by the continuous addition of the digits of the dividend. This, therefore, proves that the division is correct. As intimated, if the division had been even, there would have been no remainder and the simple product of the continuous sum of the digits of the quotient by those of the divisor, would have equaled the continuous sum of the digits of the dividend.

As in the case of the multiplication, this could have been done by the process of casting out the nines. This was shown for both the quotient and divisor in the first example, so this need not be repeated; but to apply it to the dividend, we have that the figures to cast out are, 9, 5 + 4, and 6 + 3, leaving the 4 and the 3 to be added together, making 7, which was obtained by the process of continuous addition.

Practice makes one exceedingly skilful in the use of this method of proof for multiplication and division, and it soon becomes almost automatic. For addition and subtraction, however, the process is really longer than simply going over the original figures of the problem. Its real usefulness, therefore, applies only to multiplication and division.

Holding Power of Wood Screws

By J. F. Hobart

The old question came up in the shop recently when a workman who had occasion to drive home some wood screws, persisted in driving them in nail fashion, until within about ⅛ inch of being home, then he would tighten the screw with a screw-driver. All the old arguments were brought up, pro and con, regarding the bending inward of the wood fibers when the screw was driven in, the displaced fibers being expected to arrange themselves endwise to the strain like a lot of braces under a vessel in drydock!

Becoming tired of argument, and failing to convince the mechanic by words that the hammer-screw-driver method was not "just as good," a series of tests was arranged to determine the relative strength of holding power of screws driven by the two methods noted above. The screws used were ⅜-inch No. 7, and ⅞-inch No. 11, all flat-head, bright. The screws were being used in brackets ⅛ inch thick, and were to be screwed in North Carolina pine and white oak respectively. Several tests were prepared by countersinking bits of ⅛ inch by 1 inch, flat iron to fit the screws, then driving the screws home in the iron and wood to be tested, under the same conditions which existed in the case under discussion.

When the test pieces had been prepared, they were placed in a small compression testing machine (10,000 pounds), arranged with suitable bearing pieces so that when pressure was applied, the screws would be pulled squarely out of the wood. It was found that the ⅞-inch screws in oak required almost exactly 1000 pounds to pull them out, while screws driven into bored holes of proper size, pulled out of North Carolina pine (heartwood) under a strain of 800 pounds. The ¾-inch screws, when properly screwed into bored holes in the pine, were pulled out under 550 pounds dead strain. The ¾-inch screws which were driven into the wood with a hammer, and then tightened about ⅛ inch with a screw-driver, came out of the pine at 350 pounds, showing very conclusively, and settling the matter for all time, in one shop at least, that the "hammer-screw-driver" had not a leg to stand on "when it came right down to brass tacks" and mere theory omitted.

The High School Teachers Association, of New York City, is doing considerable active work in the way of directing young people through the aid of a Students Aid Committee, in the choice of a vocation. They also have a high-school employment committee which collects information regarding opportunities for profitable and permanent employment for graduates from the high schools of New York City and advise and assist graduates and those who are compelled to leave school before completing the term, to find suitable vocations and positions. It seems as though something along this line might be done in almost every city and should do something toward preventing so many misfits in the various occupations.

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Contents

PAGE

Methods of Holding and Machining Lathe Work 573
Article Writing and Employers 576
Boring Crank Cases and Milling Cams 577
Design of Hydraulic Press Cylinders 578
Replacing Piece by Premium Plan of Paying for Work 580
Reciprocating Fixture for the Milling Machine 583
The Effects of Sulphur in Steel 585
Automatic Winding Machine for Different Shaped Pole Coils 586
Interesting Machine Tools of German Design and Make 587
Rolled Finish for Motor Shaft Journals 589
A Discussion of the Merits of Concrete for Shop Floors 591
Rough and Ready Method of Cutting Threads 594
Some Engine Lathe Attachments 595
Letters from Practical Men:
Making Currycomb Handles in Two Operations....Different Methods of Keying Sliding Worms....Press Tools for Making Small Nuts....Design of an Upright Drawing Board Frame....Simplified Formulas for Bevel Gears at Any Angle.....597-600
Discussion of the Previous Question:
Dies for Forming Tools....Bushings ....A Driving Fit....Reducing Size of Hole by Heat Treatment....Calculation of Power Loss in Slipping Belts....Truing a Crank Pin Hole ....Making the Square Hole in Socket Wrenches Cheaply....A Machine for Seasoning Castings....Dry versus Wet Grinding....A Plea for the Untrained Worker....Grinding in Gears....The Accelerating Cut on Crank Shapers.....601-604
22-inch Self Contained Roll Grinding Machine 605
Duplex Double Reduction Worm Gear Drive 606
Arithmetical Proof by Casting out the Nines 607
Holding Power of Wood Screws 608
Special Purpose Machine Tool 609
New Tools and Machine Shop Appliances 611

American Machinist

Editorial

Special Purpose Machine Tools

For discussion machine tools may be divided into three broad classes; namely, general-purpose tools, single-purpose tools and special-purpose tools. The distinctions lie in the work for which they are used. To illustrate: An engine lathe with its numerous attachments can be used for chucking, boring, facing, turning, screw cutting, and the like, on a wide variety of different pieces within its capacity, and is a general-purpose machine tool. If a lathe, however, has no special attachments and is designed for a single operation, as turning, yet is provided with adjustments so that it can be used for turning on a variety of pieces within its capacity, it is clearly a single-purpose machine tool; a machine for turning. If, however, a machine of the lathe type is designed to machine one part, as a shaft, upon which it may turn the journals, square up and chamfer the ends, and cut a thread, it is a special machine tool; that it, it is adapted to machine one special kind of pieces, and nothing else.

The special machine tool is the last refinement in machine-tool building, and, broadly, is only made possible by two developments that have taken place within the last 10 years. These are molding machines and high-speed steel.

In the use of jigs and fixtures it is recognized that castings must be uniform. This requirement is doubly strong in connection with a special machine tool; for it is possible to alter a jig or fixture slightly in order to adapt it to this lot or that lot of castings provided there has been a difference in the rapping of the pattern or shrinkage of the iron, but such altering for different lots of castings is not permissible in the case of special machine tools—the expense is far too great. Phrased a little differently, the special machine tool requires interchangeable pieces of raw material—castings or forgings or bar stock as the case may be. Interchangeable castings are only produced by the use of molding machines. Thus the molding machine is one direct contributor to the success of the specialized machine tool

The influence of high-speed steel, in its adaptability to long periods of cutting between grindings, these reducing the number of times a tool must be set, is obvious.

In addition to the self-evident advantages, in the use of such special machine tools, as the holding of each piece in the best possible way, the taking of a variety of cuts at the same time and the adapting of all of the elements of the machine to producing one definite result, there is a very important advantage which is not so apparent. This may be described as automatic measuring. It is possible to set a series of tools to a gage and limit the motion of tool holders or slides by positive stops and produce piece after piece without any direct measurements whatever and to dimensions with limits of a very few thousandths and even fractions of a thousandth. To extend this thought a little further the tools of a given special machine tool can be set by men from the tool room and the machine itself can be operated by a man incapable of measuring in thousandths but yet producing work within such limits. When a set of cutters can be used 10 hours per day for two months there is no great hardship for the tool room to care for them and set them. This is the part played by high-speed steel.

Thus far there has been but little done in regard to such special machine tools except in the textile field. From the production side the first requirement is an enormous number of pieces, and an assurance that a given type of manufactured machine will have a sustained demand. The textile-machinery building field in some lines furnishes both these assurances, and in that field there are some machine shops that have carried the building of special machine tools into the stage of a fine art. Many such machines have no resemblance to machine tools as we know them and may combine a number of operations. One that we saw recently combined milling, drilling and tapping.

Other fields are either considering this proposition or are just beginning, notably the automobile-building industry. Here, once designs are standardized and fixed, there should be as far reaching a development as in the textile field.

Many such machines have no resemblance to machine tools as we know them and may combine a number of operations. One that we saw recently, combined milling, drilling and tapping.

The financial hazard is important. Un-

less there is a volume of business sufficient to keep such machine tools employed to the advantage of the costs of the part, unless the machine in which the part is used is so standardized that it is certain that a large number will be built during the period following the building of the specialized tools, it is clearly unwise to build them. But where the condition of the industry warrants, the labor and material costs of manufacturing machine parts can be reduced to lowest terms.

The special machine tool will play an important part in the machinery manufacturing of the future.

Pratt Institute Evening Machine Class Dinner

More than 200 members of the evening machine class and alumni of Pratt Institute attended their ninth annual banquet, held at Machinery Club, New York City, on the evening of March 19. W. J. Kaup, head of the machine-shop department, acted as toastmaster, and introduced as guests, Col. R. C. McKinney, president, Niles-Bement-Pond Company, John A. Hill, publisher of this paper, W. W. Morehouse, superintendent of the Mergenthaler Linotype Company, and the Rev. L. H. Hough, all of whom made happy after-dinner remarks and gave the boys some good, wholesome advice. Frederic B. Pratt, secretary of the institute, and A. L. Williston, director of the School of Science and Technology, also made interesting addresses.

NEW PUBLICATIONS

PATTERNMAKING. By G. H. Willard; with additional chapters on CORE MAKING AND MOLDING, by F. D. Crawshaw; 224 pages, 5½x8¼ inches; 342 illustrations. Popular Mechanics Company. Cloth covers, $1.

This book deals with the hand tools and kinds of wood used; the kind of machine tools required; the kind of joints to use in different places; the turning and sawing of the work, and the making of simple, crooked and large patterns. The first hundred pages of the book are devoted to the hand and machine tools required to make patterns, the materials used, and the necessary instructions for those who are beginning to use these tools and material. The next 95 pages are devoted to the making of simple patterns; more or less crooked and complicated patterns, mostly less, and sweep work, pipe work, stove patterns, and molding-machine patterns are only lightly touched on; i.e., a few of the fundamental rules only are given and the work not gone into for any great detail. In the last fourteen pages of reading matter, F. D. Crawshaw explains a few of the fundamental principles of molding, core making and loam patterns and molds.

The book is clearly intended for the apprentice, and therefore of very little use to the mechanic. It makes the one great mistake that is made by nearly all books on patternmaking, and that is, the printing of pictures of hand and machine tools that are very crude, obsolete, and seldom met with in the pattern shops of the present day. Aside from this, however, it has a large amount of valuable information for the apprentice and is full of meat, as very few superfluous words are used.

"Elementary Course in Perspective," by Sherman M. Turrill. 71 5x7½ inch pages; 16 illustrations. The D. Van Nostrand Company, New York. $1.25 net.

In the preparation of this little volume the author has assumed that the student is more or less familiar with descriptive geometry, and he illustrates the mechanical application of the principles of that branch of mathematics to the making of a perspective drawing. He divides the book into two sections, covering two methods of making such drawings, one of these being the method by the use of the plan, the other the method by scale. The chapter headings give a good idea of the scope of the work. These are as follows: General Description of Perspective; Parallel Perspective; Angular Perspective; Perspective of Curves; Perspective of Shadows. At the end of each chapter will be found a number of problems covering the principles explained in that chapter.

CORROSION OF IRON AND STEEL. By Alfred Sang. 148 pages 5x7½ inches. McGraw-Hill Book Company, New York. Cloth $1, net.

This book goes very thoroughly into the subject, and starts off with the composition and formation of rust, following this with the different theories advanced for the cause of rusting. These are the carbonic acid, hydrogen peroxide and electrolytic theories. Of these the electrolytic theory has been the most generally accepted. The book then goes into the solution of iron in water, the action of hydrogen, carbonic oxide and carbonic dioxide, or the occluded gases, and the function of oxygen, as without these, or at least some of these elements present in steel, rusting would not occur.

The author then shows the difference between iron and steel, as well as the structures of these and the relation of the structure to corrosion. The comparative corrosion of these two metals is also dealt with at length. The effect of stress and influence of modern conditions on corrosion are shown. The corrosion that takes place in air, fresh water and salt water is given, with data and reasons for the same. Typical cases of the corrosion that has taken place in rails, tubes, wire and sheets, iron and steel are also given. Other data are supplied on the influence of the impurities in the metals, comparative corrosion of acid and basic steel, influence of electric current, and the ability of iron and steel embedded in concrete to resist corrosion is shown. The last 23 pages of the book are given over to a general bibliography of the different articles that have been printed on corrosion.

As a whole, the book contains more real practical useful information in a few pages than anything that has come under our notice for some time. The book is full of information for those who desire to know anything about corrosion, and contains the best information on that subject down to the present time.

PERSONALS

Items for This Column Are Solicited

C. K. Lassiter, mechanical supervisor of the various American Locomotive Company's plants, has had his official title changed to mechanical superintendent.

Burton S. Hughes, until recently engineering expert for the Champion Fibre Company, Canton, N. C., has opened an office in Cincinnati, O., as consulting engineer.

Cary D. Terrell, until recently connected with the Pressed Steel Car Company, is now in the sales division of the American Car and Foundry Company, St. Louis, Mo.

Charles F. Dixon, who formerly conducted a consulting engineering practice in Brooklyn, N. Y., has joined the staff of the New England Engineering Company, New Haven, Conn.

Fred H. Holz, Jr., Hans Koenigshagen and Alfred M. Hundert, of Donauwerk Ernst Krause & Company, Vienna, Austria, are in the United States familiarizing themselves with the product made by the American manufacturers they represent.

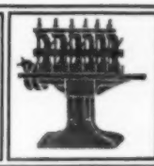
W. J. Kaup, head of the machine-shop department of Pratt Institute, is at present on a leave of absence, during which he is prosecuting some special engineering work at the Westinghouse Electric and Manufacturing Company, Pittsburg, Penn.

W. H. J. Fitzgerald, who has been in administration positions in the shoe machinery building industry for the past 25 years, and during the last eight purchasing agent of the United Shoe Machinery Company, of Boston, resigned on March 1 to take the position of president of the Union Drop Forge Company, of Providence, R. I.

Alfred Lankhuff, for a number of years connected with the Morgan Engineering Company, Alliance, Ohio, and more recently with Pawling & Harnischfeger, of Milwaukee, has opened an office in Milwaukee, Wis., as a consulting engineer, making a specialty of hydraulic, hoisting, and special machinery.

New Tools *and* Machine Shop Appliances

Showing New Ideas *in* Machine Shop Equipment *that* make *it* possible *to* do better work at a reduced cost



ANY new or improved machine or shop appliance of interest to our readers will be illustrated and described in this department.

A full and more detailed description will be given—when of special interest and it appears here before being sent elsewhere.

ALL descriptions appear in all four editions of the paper—Weekly, Monthly, Weekly English and Weekly German.

Universal Tool and Cutter Grinder

A recent product of the Woods Engineering Company, Alliance, Ohio, is illustrated in the accompanying halftones. The new machine is of the swivel head type, rigidly and compactly constructed, the work table being directly under the countershaft at all times.

The machine has been designed for a wide range of work and simply constructed. Hand wheels have been supplied in all movements so located to avoid the necessity of the operator shifting his position to manipulate them. The headstock and swivel vise make the machine adaptable for a large variety of work. The vise is universal and fits the base, which brings it close to the table for surface work. Fig. 2 shows the headstock and swivel vise in two of the many positions that may be used.

FIG. 1. UNIVERSAL TOOL AND CUTTER GRINDER

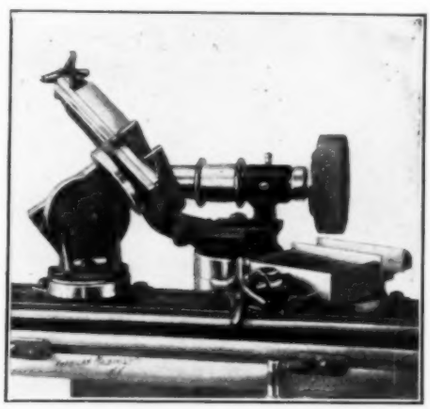


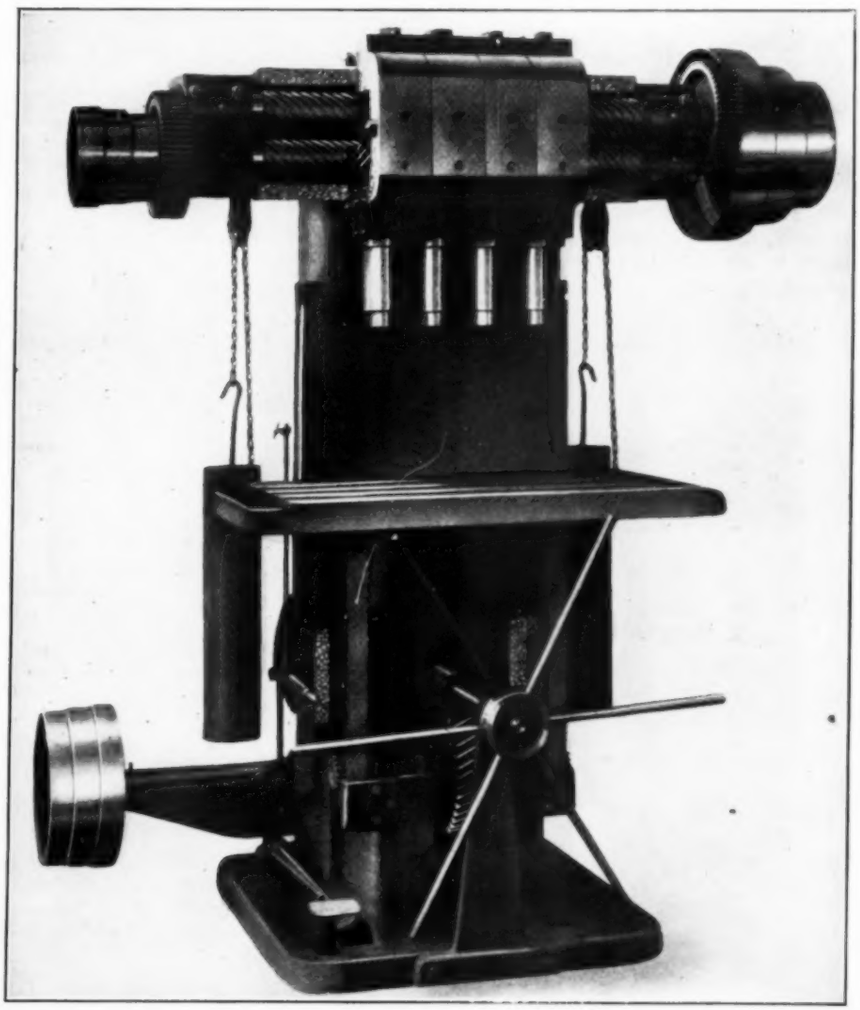
FIG. 2. HEADSTOCK AND SWIVEL VISE

Four Cylinder Boring Machine

The illustration shows a new 4-cylinder borer adapted for boring cylinders of automobiles.

In this machine the table is fed by double rack and pinion with the racks directly under the center of the table. The table is counterweighted with the counterweights conveniently located outside of the column where additional weight can easily be applied if desired. It is provided with 4 T-slots and the knee is extended above the table and provided with T-slot so that the jigs may be bolted back against the knee as well as to the table.

The spindles are bored No. 5 Morse taper and have the ends threaded to fit cutter heads or left blank. They are provided with ball thrust bearings, and



FOUR-CYLINDER BORING MACHINE

run in three phosphor-bronze bushings, the lower one of which extends below the head and enters the cylinder being bored, so that there is no overhang to the cutter heads.

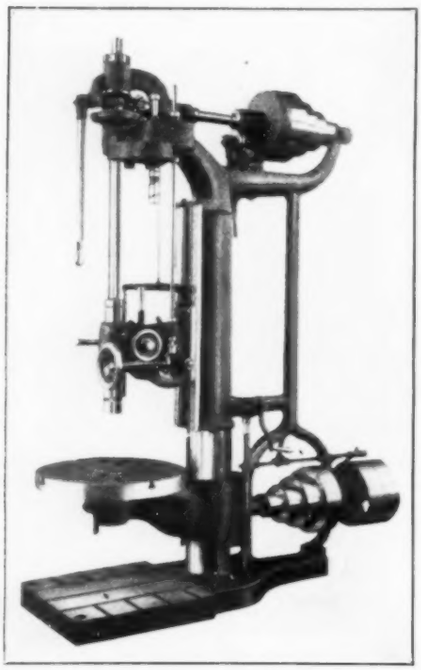
The drive is by coarse-pitch 45-degree angle, double spiral gear, the gears on the spindle being of high-grade phosphor bronze and the gears in the rail of high-carbon steel, supported their entire length and provided with ball thrust bearings to take up the end thrust.

The heads are accurately machined and scraped to a fit for close adjustment and then rigidly bolted together. Accurately ground spacer washers can be provided for setting between the heads, giving any spacing desired, and longer bolts provided so that for any setting of the heads they can be rigidly bolted, giving solid-head effect for any adjustment desired. They are accurately fitted to square ways on the rail, the lower bearing surface of the rail being the guiding member so that they are readily kept in line.

The machine is back-geared and provided with double-speed countershaft, giving six changes of speed, and is a recent product of the Moline Tool Company, Moline, Ill.

Upright Drill

The illustration shows a new 32-inch sliding-head drill. The machine is provided with positive feed, automatic stop, back gear, and geared tapping attachmen . It has eight ranges of feed, controlled by the cam sleeves below the feed box, on which the feeds are graduated.



UPRIGHT DRILL

It has a simple tapping attachment, comprised of only two gears besides the ordinary crown gear and pinion, and a quick reverse motion is obtained. The reverse crown gear is of steel, provided with a large hub bored out to a sufficient size to permit the clutch sleeve to run inside of it, thus gaining space for a long clutch sleeve not apt to bind under severe tapping strain.

The clutch sleeve, which is also made of steel, is lined on the outside with hard bronze, to make a good bearing.

This drill is a recent product of the Mechanics' Machine Company, Rockford, Illinois.

Motor Driven Grinding and Buffing Equipment

Fig. 1 shows a grinding equipment consisting of an alternating-current motor

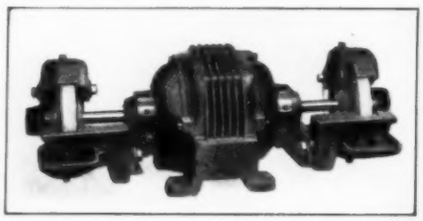


FIG. 1. A MOTOR-DRIVEN GRINDER

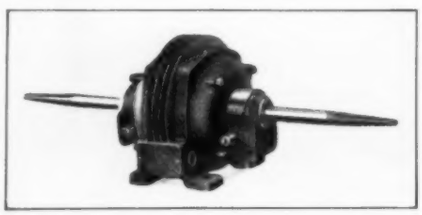


FIG. 2. A MOTOR-DRIVEN BUFF

fitted with tool rest and water attachment, bolted to the bearing brackets, but readily detachable if desired. Each end of the shaft is fitted with a flange, nut and washer, for securing the emery wheels in position. The motor is entirely inclosed, making it entirely dust and water proof.

Fig. 2 shows a buffing equipment similar in construction to the grinding outfit shown in Fig. 1, with the exception that the tool rests and water attachment are omitted and the shaft is longer and taper threaded at each end, to receive the buffs. The buffing device can be either mounted on a bench or on a post or wall.

These equipments are built by the General Electric Company, Schenectady, New York.

Vertical Cylinder Boring Machine

The illustration shows a new two-spindle vertical boring machine, built by the Beaman & Smith Company, Providence, R. I., for automobile-cylinder work. The

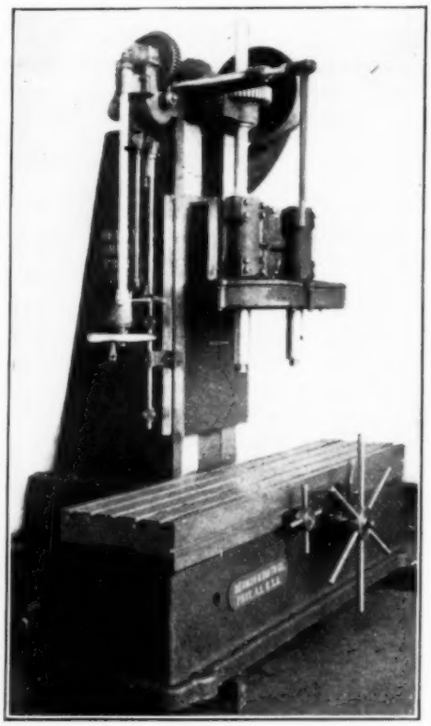


FIG. 1. VERTICAL CYLINDER BORING MACHINE

work table is 20 inches wide and 6 feet long, and is adjusted by hand. The boring spindles are carried in the saddle, which has a down feed for boring and a

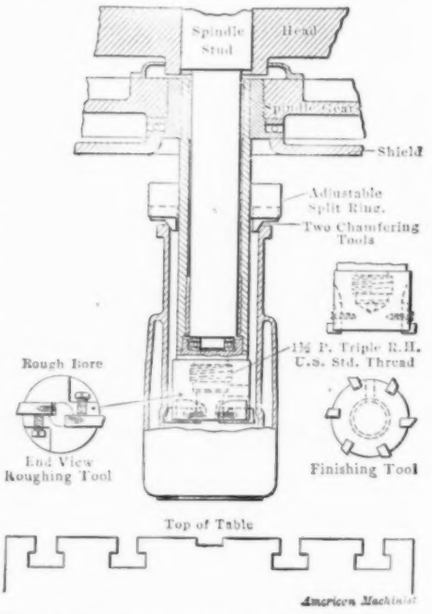


FIG. 2. DETAILS OF VERTICAL CYLINDER BORING MACHINE

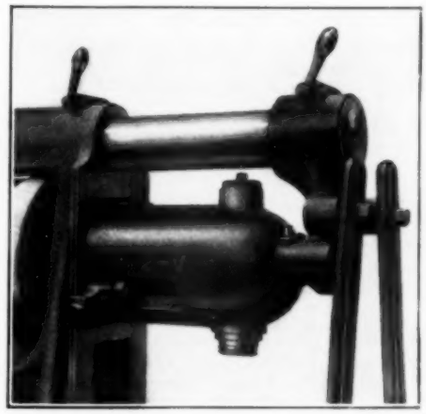
quick return, both being operated by power. The machine is designed for boring cylinders in any combination from single castings to the block method which is used by some makers. The long bed enables one set of castings to be bored while another set is being placed in position.

The special feature of the machine is the novel boring spindle on which a patent is pending, and which is illustrated in Fig. 2. This consists of a very rigid spindle stud, on which the boring head revolves, so that the cutting points are supported as closely as possible under the work being done. The thrust is taken on the ball bearing shown between the end of the spindle stud and the boring head, while the upper ball bearing supports the weight of the spindle and the attached parts.

This construction admits of using gears of large diameter for driving the spindle, and also of a large spindle stud, which can be made very stiff and insures a good cylinder bore. This boring-bar construction will also be used on their horizontal boring machines, and we understand that it has been giving very satisfactory service.

A Vertical Milling Attachment

The halftone shows a vertical spindle attachment manufactured by the Garvin Machine Company, of New York City, as applied to their No. 2 universal milling machine. As the attachment is for vertical milling only, it can be adjusted only slightly in either direction to clear the cutter and prevent drag whichever way the table is feeding. The casting is bolted to the column by three bolts, and also



A Vertical Milling Attachment

clamps to the V's of the base, where the slight adjustment mentioned above is obtained. The attachment is driven by miter gears of a coarse pitch. The spindle has a No. 10 B. and S. taper hole in it and is provided with a draw-in rod. The lower bearing is taper and runs in a solid self-oiling bronze box. The upper bearing is straight and runs in an adjustable bronze box, provided with a take-up nut for wear. The nose of the spindle is 2½ inches diameter, 4-pitch, left-hand V-thread. The attachment is manufactured in two sizes, and may be applied to many sizes of Garvin milling machines.

A Universal Milling Machine

The halftones show a heavier design of their No. 25 universal milling machine, which has recently been brought out by the Oesterlein Machine Company, Cincinnati, Ohio.

The automatic feeds to the table are transmitted from the spindle through a roller chain to the sprocket wheel on the feed box. A direct-reading index plate on the feed box indicates the feed per revolution of the spindle. The universal head will divide work in any position from 10 degrees below horizontal to 10 degrees beyond vertical. A feature of the head is the rapid spacing of 2, 3, 4, 6, 8, 12, and 24 divisions. The head is provided with a complete set of change gears, 3 division plates, a tailstock and center rest. The 3 plates give all divisions to 100, all even and numbers divisible by 5 to 200, and many others. The tailstock can be swiveled to any angle for taper work. The longitudinal traverse is 25 inches, cross feed 7½ inches, and the distance from the spindle to the table at its lowest position, 18 inches.

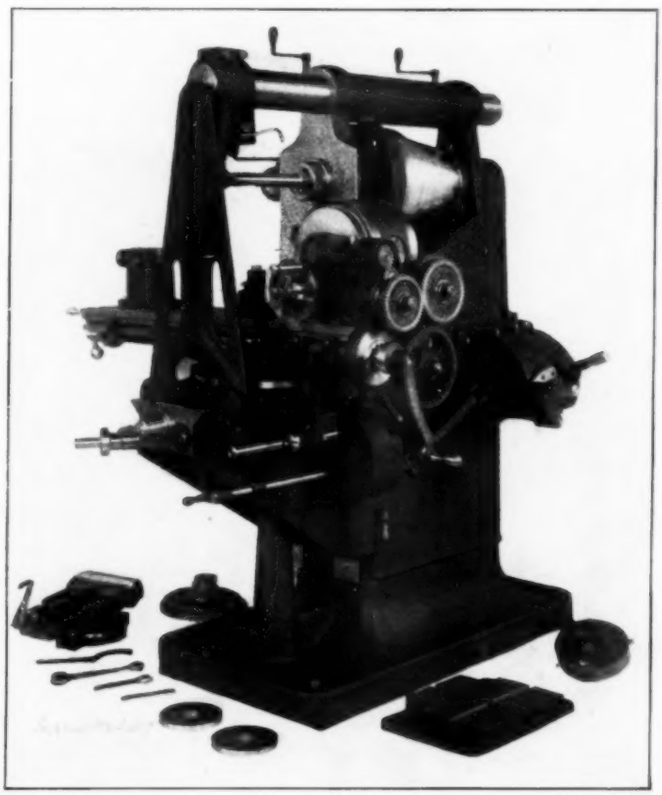
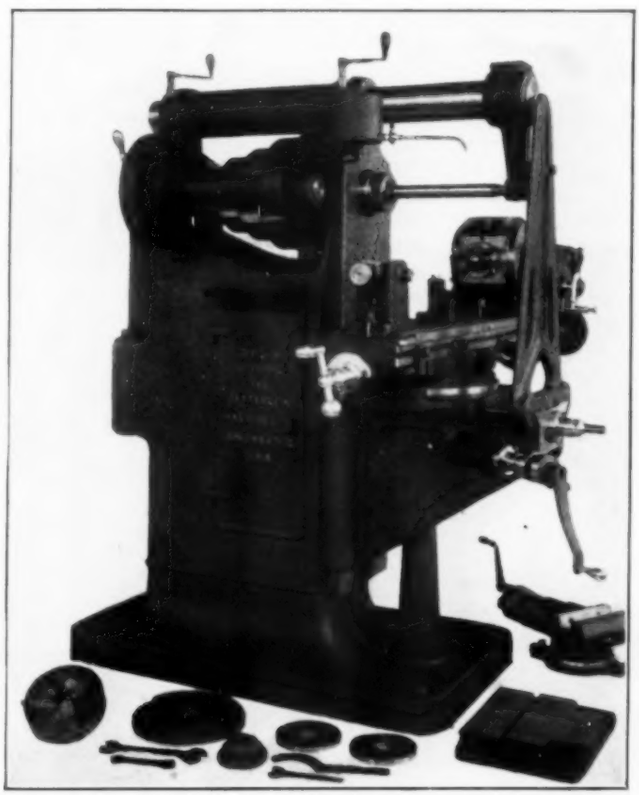


Fig. 1



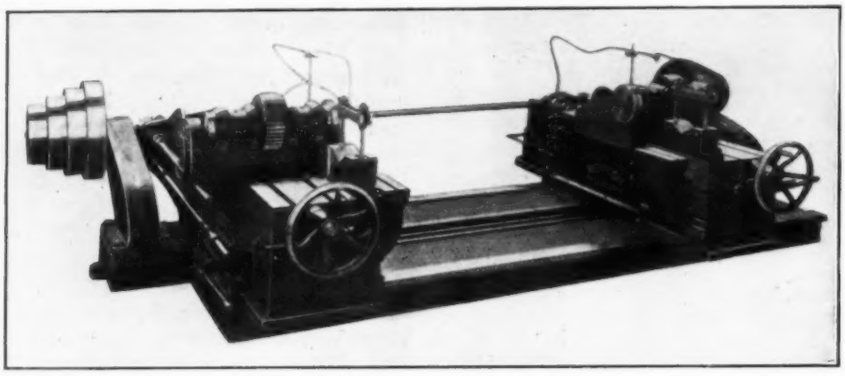
A Universal Milling Machine

Fig. 2

A Belt Driven Double Cold Saw

The halftone shows a newly designed belt-driven cold-saw cutting-off machine, being an adaptation of the bar type machines arranged right and left hand, mounted on a floor plate and intended to reduce the idle time of the machine 50 per cent., as two cuts can be made with one setting of the work.

These machines, carrying saw blades 32 inches in diameter, have capacity for round stock 9½ inches, square stock 9 inches, and for I-beams on a square or miter cut in vertical position up to 20 inches. The machines are of the standard spindle-driven type, spindle being supported at each end by capped bearings and driven by broad-face, coarse-pitch, hammered steel gearing through worm and worm wheel, worm wheel having a bronze ring and the worm being of hardened steel fitted with roller thrust bearings, both incased for continual lubrication. The spindle saddle has square-locked gibbed bearings on the bed, with taper shoes to compensate for wear, and is provided with constant feed variable in rate with adjustable automatic and positive safety release and power quick return available in both directions.



A Belt-driven Double Cold Saw

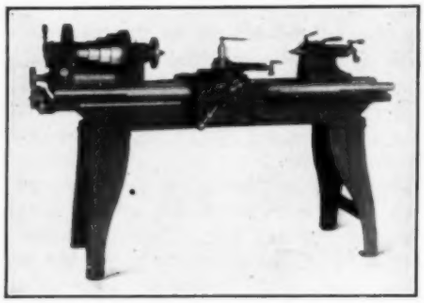
The drive on these particular machines is by means of independent four-step cones giving four periphery speeds to the saw blades. An important feature in the design of this machine is that the bed and work table are one casting. Auxiliary supports are furnished to attach to the vertical clamping surface in order that materials may be supported on each side of the saw blade.

The machines are furnished complete with pump, piping and attachments for cutter lubrication, as experience has shown that to obtain the most efficient results from the high-speed, tool-steel blades, it is necessary to deluge the cutting point with heat-absorbing and lubricating fluids.

This type of machine is manufactured by the Newton Machine Tool Works, Inc., Philadelphia, Penn., in four sizes, having capacities for 5½-, 7½-, 9½- and 11½-inch diameter rounds, and arranged with adjustment from a minimum distance of ¼ inch between the center of saw blades to a maximum distance of any desired length.

A 13-inch Screw Cutting Lathe

The halftone shows a new size of lathe which has been added to the "Star" line of lathes built by the Seneca Falls Manufacturing Company, 687 Water street, Seneca Falls, N. Y. The lathe swings 14⅛ inches over the bed. The spindle has a 1⅛-inch hole through it. The carriage is provided with T-slots and automatic long- and cross-feeds. The cross-feed screw is provided with a graduated collar reading to thousandths. The lathe is provided with both plain and compound rests which are easily interchanged. All standard screws both right and left from 3 to 72 per inch, including 11½, may be cut with the change gears provided. All adjusting screws are of uniform size and fit the tool-post wrench.

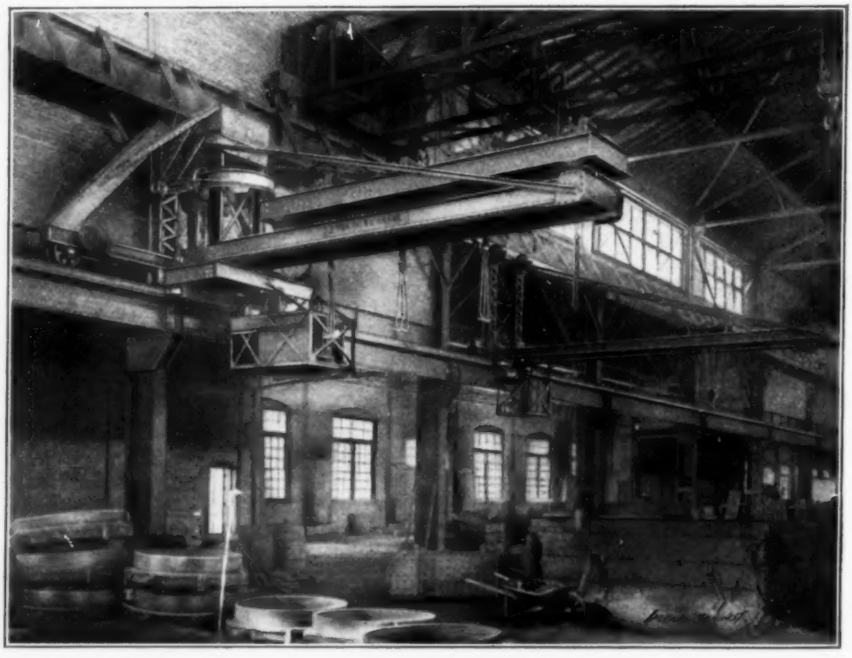


A 13-inch Screw-cutting Lathe

When desired blocking to increase the swing of the lathe to 20⅛ inches can be fitted to the lathe.

Special Foundry Crane

The illustration shows a somewhat unusual form of wall crane recently installed in the Roanoke shop of the Norfolk & Western Railway, Roanoke, W. Va. This is a 2-ton crane which can be moved along the wall to any desired position and in addition can be swung about a central bearing by the wire rope on the drum shown, through an arc of 90 degrees. This is equipped with a special 4-hook trolley, each being operated by an independent hoisting mechanism equipped with a Niles double disk lead brake and independent motor.



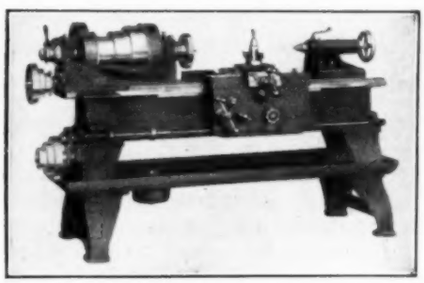
An Unusual Form of Wall Crane

A special master controller is located in the cage so that all four hoists can be operated together or independently as desired. The trolley has a short movement of only 18 inches on the crane beams, to allow for slight changes in position of the hoisting hooks with reference to the side wall of the building. This is made by the Niles works of the Niles-Bement Pond Company, Hamilton, Ohio.

A Heavy Plain Turning Lathe

The lathe shown in the halftone was designed for the rapid production of turned work.

While nominally a 14-inch lathe it swings 16⅝ inches over the bed. The spindle has a 1⅛-inch hole through it. The front bearing is 2¾ inches diameter



A Heavy Plain Turning Lathe

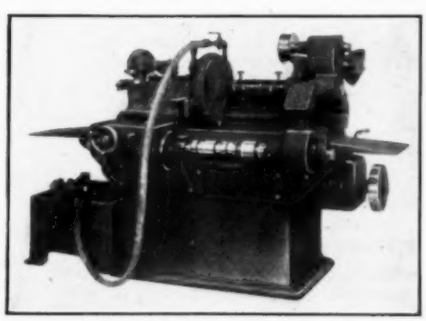
by 6⅝ inches long. The largest diameter of the three-step cone is 12 inches, it accommodates a 3¼-inch belt.

The tail spindle is 2⅜ inches diameter and it has a bearing in the tailstock 8 inches in length. The machine is equipped with a special heavy plain rest. The feed works are driven by a 1¼-inch belt. Usually no lead screw is supplied but one can be furnished at extra cost. The lathe throughout is extra heavy in construction and has the power and stiffness of the ordinary 20-inch lathe.

It is built by the F. E. Reed Company, Worcester, Mass.

A Cam Grinder

The Landis Tool Company, Waynesboro, Penn., has just placed on the market the cam-grinding equipment shown in



A Cam Grinder

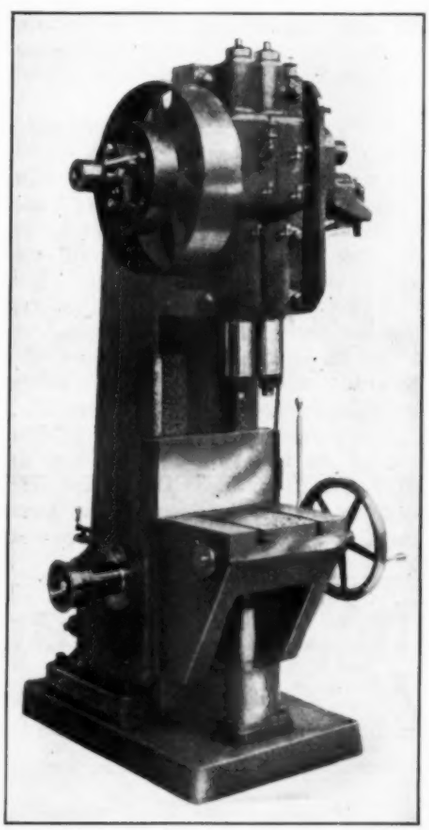
the halftone. It is used on their regular universal and plain grinders.

The attachment grinds its own enlarged master cams from full size models of the work to be ground. Any slight change in form of the work due to wear of the wheel is compensated for by a set of change master-cam shoe plates which are a part of the regular equipment. The reciprocating cross motion of the wheel takes place only when it is opposite the cam to be ground. The only alteration necessary when changing to cylindrical work is to disengage the grinding head from the master cam.

A Two Spindle Cylinder Boring Machine

The machine shown in the halftone was designed for boring twin automatic cylinders, but will handle four-cylinder castings where they are cast in block. It will bore cylinders up to 6 inches diameter by 14 inches in length.

The left-hand spindle bracket is rigidly secured to the frame, while the right-hand one is adjustable, giving from 4½



A 2-cylinder Boring Machine

to 6½ inches, center distances. The accurate setting of the adjustable spindle bracket is facilitated by micrometer screws. The table measures 14¾ by 18½ inches, is counterbalanced, has a vertical feed of 18 inches, a quick return and automatic stop. Distance from center of spindles to column, 9¼ inches.

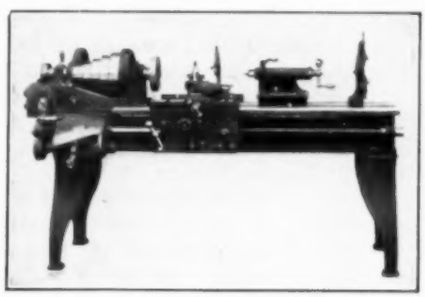
Nine feeds are provided, giving from 0.03 to 0.2 inch per turn of the spindle.

Floor space occupied is 34 by 48 inches. The machine weighs about 4500 pounds, and can be arranged for independent motor drive. It is built by Baker Brothers, Toledo, Ohio.

A 14-inch Engine Lathe

The halftone shows a 14-inch quick change gear engine lathe, which is being placed on the market by the machinery and equipment department of the Cincinnati Iron and Steel Company, Cincinnati, Ohio.

The lathe has a swing of 15⅜ inches, with hole in spindle for 1 5/16 stock, and is equipped with either 4- or 5-step cone. Only two levers are required for the quick-change gear, cutting threads



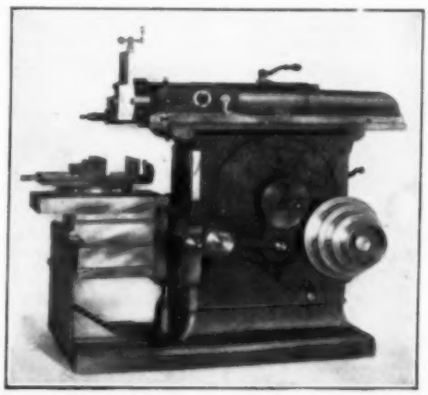
A 14-inch Engine Lathe

from 3 to 32. The range of feeds is from 18 to 192 per inch, with 33 changes. It is impossible to engage two gears at the same time. Taper attachment can be furnished at any time, the carriage being jig drilled for this purpose.

A 24-inch Shaper

The halftone shows a 24-inch back-geared shaper, which has been brought out by the Stockbridge Machine Company, Worcester, Mass. The direct drive gives a ratio of 6 to 1, and with the back gears in a ratio of 30 to 1 is obtained.

The side thrust of the ram is taken by a gib, adjusting screws being provided



A 24-inch Shaper

to take care of wear. The cross-feed mechanism adjusts itself to any position of the saddle, feeds in either direction and stops automatically at either end of the feed.

The driving cone is supported on a sleeve running on a self-oiling bearing, thus avoiding all side pull on the main shaft.

The shaper can also be supplied with single-step pulley and gear-box drive.

The horizontal traverse of the table is 30 inches, vertical traverse 15 inches. The table top is 16 inches wide by 24 inches long. The machine weighs 4400 pounds and requires a floor space 102 by 52 inches, thus making a compact and rigidly constructed machine.

Geared Drives and Feeds—Shop Departments *By John R. Godfrey*

The question of geared drives and geared feeds is far from settled in the minds of those who are making and buying machinery. One large builder makes geared feeds under protest, and carefully lays them aside in his own shop. He also builds a quick-change feed box that seems to be very simple, yet he has to increase his belt width 20 per cent. over the old lathes to get the required power.

Another builder is enthusiastic over his geared head and uses it on all his machines for his own work. Still another builder uses a friction feed, as few gears as possible anywhere, high belt speed, and gets good results. His friction feed can stall the machine any time.

There is a reason for all this in the fact that all of them are good in certain places. Probably every one of them is best under certain conditions. The trouble is, we try to use all three in all conditions.

No one who has seen the way a good operator handles a geared-head chucking or turret lathe, can doubt that he changes speeds for the different work of drilling, facing and boring, much easier and faster than he could with the regular cone and belt. Where work requires frequent speed changes the geared head seems to warrant the extra power it undoubtedly consumes. It is a sort of a gaining speed at the expense of power.

Engine-lathe work, on the other hand, does not require nearly as frequent speed changes as a rule, often running all day on approximately the same diameter, and the need does not seem nearly so acute, so that the power question looms up a little larger.

The feed question is not so much a time saver, for the rate of feed does not vary as much as the speed of the work, and becomes largely a question of power to carry the cut. There are cases, to be sure, such as milling the edges of a box, where the cutter spans both sides, where the feed can be faster after it gets into the cut, and where this will be done if the change is easy. But the necessity seems much less than with the drive of a milling cutter.

Dividing Shops into Departments

Just as it is a wise man who knows the right tools to buy, so it is the wise foreman or superintendent who knows just how to divide his work into departments.

A friend of mine got the department fever some time ago, grouped all his drilling machines together into a drilling department, and had work from all over the shop carried here to be drilled. He put this in charge of a good drill man and all went smoothly—for a little while.

A visit the other day revealed the fact that he had changed things again, and while he still had most of his drills grouped, there were others scattered through the shop in other departments.

This all came about through the drilling of an important piece, where the drilling had to be done at different times and was neither the first nor last operation. This meant carrying the piece back and forth, with its consequent delay and expense, and it was obviously a wise plan to bring the drills to the work, rather than insist on the department idea under all circumstances.

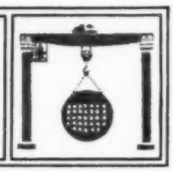
The drilling department is usually a good thing, but the work must always be considered, and there is no fixed rule which always holds good.

All of which leads to the old truism that the successful man in the shop is the one who makes the best compromise between the ideal and his actual conditions.

An accident to the exhaust fan, which took enough dust from the emery grinders to make the shop habitable in their vicinity put the fan out of business for nearly two days. The moral standard of the mechanics seemed doomed to lose many credits on account of the dust and profanity, when one of the young men saved the day by running an electric light wire to the roof and connecting same to an ordinary office fan used for ventilating. The fan was then placed on top of the dust pipe, which extended vertically through the roof; after being fastened in a vertical position with the wheel downward and the dust pipe wired firmly against the wire guard of the fan, it was started going, and the work it did in taking away most of the dust, was really remarkable when the size of the fan and the current consumed were considered. It kept the lighter dust moving right out of the shop until the repairs on the big fan were finished.

Increasing Shop Capacities

Where More Tools will be needed



The Batesville (Ark.) Ice Company will install an additional boiler.

The Flower Hospital, New York, will install a new engine and boiler.

The United States Glass Company is to enlarge its plant at Glassport, Penn.

The installation of a water-works system is being considered at Alma, Wis.

The Peter Breidt Brewing Company, Elizabeth, N. J., will enlarge its power plant.

The Bessemer Gas Engine Company, Grove City, Penn., is enlarging its plant.

A new roundhouse will be built by the Panhandle Railroad at Crestline, Ohio.

Authentic news is solicited for this department. Real opportunities for the sale of machinery of any kind.

The Berlin (Ont.) Table Company will double the capacity of its plant.

The Cincinnati (Ohio) Reduction Company is to erect three additions to its plant.

The Fairbanks-Morse Company, Beloit, Wis., is taking bids on a new machine shop.

Schimming & Eddins, Marlin, Tex., will erect a two-story machine shop and garage.

The Weilbacher Silk Company, Allentown, Penn., is erecting a two-story addition.

Fire destroyed the plant of the Standard Box and Lumber Company at Millvale, Penn.

The Waclark Wire Company, Bayway, N. J., will build an addition to its power house.

The Kootenay Steam Laundry and Dye Works, Cranbrook, B. C., will erect a new laundry.

The Standard Oil Company, Bayway, N. J., will increase the capacity of its power plant.

The Northwestern Knitting Company, Minneapolis, Minn., will erect a $100,000 addition.

The Hankinson (N. D.) Cement Block and Building Company will erect a new factory.

The gin and ice plant of S. T. Fritz, Whitesboro, Tex., was destroyed by fire. Loss, $12,000.

The New York State Steel Company, Buffalo, N. Y., will add a 65-ton open hearth furnace.

C. A. Laurson, Howard, S. D., has applied for a franchise to operate an electric-light plant.

The Canton (Ohio) Drop Forge Company has taken out a permit for an addition to its plant.

Campbell & Wygandt, Muskegon, Mich., will erect a new foundry at Muskegon Heights.

The Greenville Coal and Ice Company, Jersey City, N. J., is to erect an addition to its plant.

The Worcester (Mass.) Electric Light Company is having plans prepared for a new plant.

The G. Buehler Furniture Company, Allentown, Penn., is erecting a three-story addition.

The Arlington Mills, Lawrence, Mass., is erecting an additional two-story boiler house.

The Olympia Brewery Company, of Cordova, Wash., will erect a $75,000 cold-storage plant.

The Hupp-Turner Company, machinists, Detroit, Mich., will construct a new machine shop.

Joseph Hensler Brewing Company, Newark, N. J., is building a new plant; also a power house.

The Rising Sun Brewing Company, Elizabeth, N. J., will increase the capacity of its power plant.

The plant of the Southern Horse Shoe Nail Company, Gadsden, Ala., was destroyed by fire.

The Lobee Pump and Machinery Company, Buffalo, N. Y., is receiving bids for a new factory.

The American Paper Tube Company, Woonsocket, R. I., is erecting an addition to its plant.

Fire caused $750,000 damage at the brewery of N. Seitz's Son, 260 Maujer street, Brooklyn, N. Y.

The American Express Company will put in a new power plant at East 44th street, New York.

The Dahlstrom Metallic Door Company, Jamestown, N. Y., is building another addition to its plant.

The Bradley Company, Delevan, Wis., is considering the installation of a modern power plant.

The American Gas and Electric Power Company will erect a $300,000 plant at Georgetown, Wash.

The Oscar Krenz Brass and Copper Company, of San Francisco, is to erect a plant in Seattle, Wash.

The Hercules Specialty Company, Grove City, Penn., will engage in the manufacture of motor trucks.

Gilborne Bros., Aberdeen, S. D., have been granted a franchise to install a power and heating system.

The Poidebard Silk Manufacturing Company, West Hoboken, N. J., will build an addition to its mill.

The Success Stove Company, Erie, Penn., recently organized, is planning the erection of a plant.

The box and shook factory of E. S. Adkins & Co., Salisbury, Md., was burned. Loss, abou $35,000.

The plant of the Sheboygan (Mich.) Boiler Works was destroyed by fire. Loss, about $10,000.

The Twin City Woodworking Company, Chehalis, Wash., is to increase the capacity of its plant.

Rutherford Bros., Muncie, Ind., are to erect a factory for the manufacture of heavy chandeliers, etc.

Geo. Crysler, of Wadena, Minn., has been granted a franchise and will install an electric-light plant.

The National Briquetting Company, Minneapolis, Minn., will erect a $15,000 plant at Kenmore, N. D.

The West End Thread Company, Bramanville, Mass., has let contract for an addition to its plant.

Plans have been completed for a new foundry for the Acme Steel and Malleable Iron Works, Buffalo, N. Y.

The Gleason Company, Rochester, N. Y., has applied for a permit for a new factory to cost about $45,000.

The Screiber Motor Car Company, Milwaukee, Wis., will build a $30,000 garage at 12th and Grand avenues.

The sawmill of the Lee Wilson Lumber Company, at Wilson, Ark., was destroyed by fire. It will be rebuilt.

The Jantz & Leist Electric Company, Cincinnati, Ohio, will install an additional 55-horsepower engine.

The Ohio Blower Company, Cleveland, Ohio, has purchased a site on which a new and larger plant will be erected.

The Newport (Ark.) Light, Water and Power Company will install a new boiler, engine and generator.

J. C. Milne, of Sturgis, S. D., is organizing a company for the purpose of erecting a canning factory at Vale, S. D.

The Covington (Va.) Machine Company intends spending $75,000 this year in enlarging and improving their plant.

The Universal Roller Bearing Company, 25 Broad street, New York, has plans almost completed for a new factory.

Fire damaged the plant of the Valley City Desk Company, Grand Rapids, Mich., to the extent of about $75,000.

The Canadian Coal Consolidated, Ltd., will build a 3000-horsepower steam power plant at Frank, Alberta, Can.

The Prospect Artificial Ice Company is erecting a plant at Bergen street and Classon avenue, Brooklyn, N. Y.

The Woodruff & Pausch Stone Company, Columbus, Ohio, plans to install a number of large stone crushers.

The elevator of the Independent Elevator Company, of Minneapolis, Minn., at Mayville, N. D., was destroyed by fire.

The Newport (Ark.) Ice and Cold Storage Company will install a 30-kilowatt, direct-connected generating set.

The American Tool Works Company, Cincinnati, Ohio, contemplates the purchase of a 60-horsepower gas engine.

The Timken Detroit Axle Company, Detroit, Mich., has plans prepared for several new buildings, including a forge plant.

Pickard Bros., Brockton, Mass., automobile manufacturers, are making arrangements for an enlargement of their plant.

The Lozier Motor Car Company, Detroit, Mich. has purchased the site for its plant. Temporary offices are in the Ford building.

Scar Nelson will erect a canning factory at Lake Mills, Iowa, to cost $15,000. Kinney & Fogerst, of Minneapolis, architects.

The Lawrence (Mass.) Gas Company contemplates the installation of a steam turbine or Corliss engine in its power plant.

A building permit has been issued to the Pabst Brewing Company, Milwaukee, Wis., for the erection of a boiler house and shop

The Atlantic Screw Works, Hartford, Conn., will enlarge the present main building and erect two additional three-story buildings.

Fire destroyed the Mineral Springs plant of the Lehigh Valley Coal Company, Wilkes-Barre, Penn. Loss, about $250,000.

The S. G. Hunter Iron and Bridge Works, Atlantic, Iowa, will build an addition to its plant. New machinery will be needed.

The Western Packing Company, Denver, Colo., has let contracts for the construction of a $40,000 plant in Salt Lake City.

Dr. S. B. Hartman, Columbus, Ohio, head of the Peruna Company, is to erect a large power house on his 10,000-acre farm.

The Queen City Gin Company, Gadsden, Ala., is preparing to erect a new $12,000 plant. New equipment will be installed.

The Fort Wayne (Ind.) Electric Works has purchased more land and will commence the erection of two large additions this summer.

The Ireland & Matthews Manufacturing Company, Detroit, Mich., is erecting a two-story addition to its sheet metal factory.

The Taylor Steel Company, of Columbus, Ohio, incorporated some months ago, is erecting steel castings plant at Plain City.

The Safety Car Heating and Lighting Company, Jersey City, N. J., is to build an addition to its plant and also increase the power plant.

Kearney & Trecker, making milling machines, Milwaukee, Wis., is to erect a new plant which will double its present capacity.

The Ingersoll-Rand Company, 11 Broadway, New York, is preparing a list of additional machinery required for the plant at Phillipsburg, N. J.

The Schacht Manufacturing Company, Cincinnati, Ohio, will move its automobile plant to Sandusky, Ohio, where new buildings will be erected.

The Isthmian Canal Commission, Washington, D. C., will receive bids up to 10:30 a.m., April 18, for four steel rock and sand barges as per Circular No. 568.

The Harley-Davidson Company, Milwaukee, Wis., manufacturing motorcycles, has taken out a building permit for an addition to its factory.

The Buffalo (N. Y.) Foundry and Machine Company has placed contracts for the erection of an addition to its machine shop to cost $200,000.

The bone house of Swift & Co., South Omaha, Neb., was ruined by fire, causing a loss of $20,000. Building was used for grinding bones.

The J. E. Mergott Company, Newark, N. J., will erect a new four-story building to cost about $35,000. The company manufactures pocket-book frames.

The O. M. Edwards Company, Syracuse, N. Y., expect in the near future to go extensively into the manufacture of iron and steel valves.

The International Steel Tie Company, a $2,000,000 Pennsylvania corporation, will establish a branch plant in Chicago, Ill., to cost $1,000,000.

The Marokene Company, Elizabeth, N. J., manufacturing imitation leather, will build an addition to its plant; also increase the capacity of the power plant.

The G. J. Lippert Furniture Company, Berlin, Ont., a new concern, will shortly commence the erection of a factory for the manufacture of tables.

Westinghouse, Church, Kerr & Co., 10 Bridge street, New York, have issued a list of machine tools and equipment required for railfoad shops at Huntington, W. Va.

The car repair shops of the Kansas City, Mexico & Orient Railway Company, at Fairview, Okla., were burned, causing a loss of $100,000. They will be rebuilt.

The Monitor Automobile Works, Chicago, Ill., is moving its factory to Jeanesville, Wis., where larger quarters have been secured. New equipment is being purchased.

The Walker & Pratt Company, Watertown Mass., manufacturer of cooking ranges, is to build an addition to its plant which will add one-third to its capacity.

The Aldrich Manufacturing Company, Buffalo, N. Y., is building additions to its plant. The company manufactures copper and brass utensils for hotel and domestic uses.

The Vaughn Manufacturing Company, Jefferson, Wis., is said to be considering the manufacture of auto-vehicles to be used in connection with agricultural operations.

The Billings & Spencer Company, of Hartford, Conn., will move its drop forging plant to Dividend, Rocky Hill, Conn. Buildings wil be put up as soon as possible.

The Fayette R. Plumb Company, of Philadelphia, makers of Keen Kutter hardware, etc., has acquired a site in St. Louis on which a $1,000,000 plant will be erected.

The Reliance Electric and Engineering Company, Cleveland, Ohio, has authorized Dodge & Day, of Philadelphia, to prepare preliminary plans for a new plant.

The Cross-Hinds Company, Syracuse, N. Y., machinery manufacturer, is completing plans for proposed new factory buildings. A number of machine tools will be required.

The Northwestern Wheel and Wagon Company, Portland, Ore., is having plans prepared for a new factory, power house and office building to cost $50,000.

It has been announced that 20 more open-hearth furnaces are to be added to the plant of the National Tube Company, at Lorain, Ohio. About $5,000,000 is to be expended.

Fire destroyed a large part of the plants of the P. A. Starck Piano Company and the Edward Hines Lumber Company, Chicago, Ill., causing about $500,000 loss.

The Grant-Lees Machine Company, Cleveland, Ohio, will soon occupy their new three story addition, in which new machinery, to cost about $50,000, will be installed.

The Isthmian Canal Commission, Washington, D. C., will receive bids up to 10:30 a.m., April 19, for piles, stay-bolt iron, brass screws, sulphate of copper, etc., as per Circular No. 569.

Fire destroyed the Springwells plant of the Roe Stephens Manufacturing Company, Detroit, Mich., causing a loss of $250,000. The company manufactures valves, fire hyrdants, etc.

The Chesapeake & Ohio Railroad Company is erecting a large yard at Silver Grove, Ky. Machine shop will be built to be equipped with modern machinery for repairing locomotives and cars.

The Globe Stove and Range Company, Kokomo, Ind., has commenced the erection of additions which will double the capacity. One of the additions will be a foundry and one a nickel-plating shop.

James McCurrach & Bro., 561 Broadway, New York, have built an extension to their factory at 138 Stone avenue, Brooklyn, N. Y., and will install a 30-horsepower gas producer plant, motors, dynamo, etc.

The Hudson & Manhattan Railway Company will shortly commence work on shops to be erected in Jersey City, N. J. The buildings will comprise car shop, repair shop, truck and blacksmith shop, etc.

The Grote Manufacturing Company, Evansville, Ind., will erect a new plant for the manufacture of its heating appliances and elevators to cost $100,000, and which will be double the size of the present one.

Bids will be received until 10 a.m., April 13, for an electric-light and power plant and electric-lighting system at Fort Sill, Okla. Plans can be had of Capt. Daniel L. Stone, constructing quartermaster, Fort Sill.

The Commercial Club, of Muskegon, Mich., has received a proposition from the Oklahoma Malleable Iron Company, to erect a $100,000 plant for the manufacture of iron castings and builders' hardware.

C. H. Doerr, of C. H. Doerr & Co., Berlin, Ont., manufacturing biscuits and confectionery, has dissolved partnership and will organize a new company with $100,000 capital. Plant will be enlarged.

The D. T. Williams Valve Company, Cincinnati, Ohio, will start about April 1, the erection of ts new four-story plant. Considerable new equipment is to be installed in addition to that now in use.

Fire destroyed the garage of Joseph G. Reeves, 106-08 North Seventh street, Camden, N. J. Nineteen automobiles, valued at $75,000, were burned and personal loss of Mr. Reeves is about $10,000.

The Barndt & Johnston Auto Supply Company has purchased the plant of the Columbus Woodenware Company in South Columbus, which will be remodeled into an automobile accessory manufacturing plant.

Plans are drawn and contracts will be awarded for additions to the plant of the Norton Company in Greendale, Mass. About $50,000 will be spent. The main addition will be devoted to the manufacture of grinding wheels.

The Snow & Petrelli Manufacturing Company, New Haven, Conn., whose plant recently burned, is installing new machinery in a new factory on Brewery street. The company manufactures hardware specialties.

The Glidden Varnish Company, of Cleveland, Ohio, has acquired the plant of the Blackwell Varnishes, Ltd., Toronto, Canada, and organized the Glidden Varnish Company, Ltd. The plant is being remodeled and the capacity will be increased.

A contract has been awarded for the construction of buildings at Cape Charles, Va., for the New York, Philadelphia & Norfolk Railroad Company. These will include a power plant, machine shop, erecting shop, blacksmith shop and roundhouse.

Announcement has been made that the American Locomotive Company has awarded a contract for the construction of a manufacturing plant and steam shovel works at Gary, Ind. The cost is to be $3,000,000. There will be twelve buildings and a power house.

The Waterville (Ohio) Traction Company, capitalized at $50,000, and organized by W. W. Farnsworth, D. Sheldon, A. E. Zock and others, has purchased site for a plant which will employ about 200 men. Motor trucks will be manufactured.

The Sunset Mining and Smelting Company, a Terre Haute, Ind., corporation, is receiving bids for a 60-horsepower engine and air compressor of 300 cubic feet to place on its property in Hell's Canyon, N. M. They also contemplate the erection of a 350-ton smelter plant.

Bids will be received until 11 a.m., April 11, for the installation of new boilers, new pump, feed-water purification system, feed pump, etc., in the pump house at Fort Robinson, Neb. Information can be obtained of Capt. Malvern-Hill Barnum, constructing quartermaster, Fort Robinson.

The Belmont Automobile Company, backed by New York capital, has recently opened a factory on Lawrence street, New Haven, Conn., which is used particularly for test work, but are considering enlarging same and manufacturing automobile parts along with the assembling and test work.

The Secor Typewriter Company, succeeding the Williams Typewriter Company, Derby, Conn., is preparing to place a new model typewriter on the market, which will require an additional working force of from three to four hundred hands. Plans are under way for enlargement of the plant t accommodate this extra force.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open the following bids: April 19—sprue cutter, sensitive bench drill, metal saw cutting-off machine, core-making machine, valve reseating machine, arbor bench press, metal saw table (schedule 2335), glass grinding machine (schedule 2334), hand tools (schedule 2343).

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open the following bids: April 12—Water meters (schedule 2353), steel-plate fan (schedule 2357), recording wattmeters (schedule 2353), round rod bronze, nickel steel forgings, zinc sheets (schedule 2356), cast-iron pipe, double-gate valves (schedule 2353), brass tubing (schedule 2358), engraving machine (schedule 2349); April 26—Vacuum drying apparatus (schedule 2348), motors (schedule 2360), cable, oil-cooled transformers, weather-proof wire (schedule 2359).

NEW INCORPORATIONS

Southern Ice and Power Company, Corning, Ark. Geo. A. Booser, president and manager.

Peat Coal and Gas Machinery Company, Toledo, Ohio. Manufacture gas machinery, etc. Capital, $10,000. Incorporators, A. J. Grabach, etc.

Automatic Paper Box Works, Chicago, Ill. Box and boxmaking machines. Capital, $10,000. Incorporators, Edward J. O.Neil, William Friedman, T. H. Hardy.

Union Clay Company, Empire, Ohio. Manufacture brick, etc. Capital, $200,000. Incorporators, George M. Myers, Thos. J. Myers, James Porter, etc.

South-Juergens Motor Car Company, Fremont, Ohio. Manufacture motor trucks and delivery wagons. Capital, $150,000. Incorporators, R. C. Traver, etc.

Williard Automatic Press Company, New York. Manufacture automatic printing presses, etc. Capital, $100,000. Incorporators, Thos. McNally, Frank Stafford, Lewis Heuer, Jr.

Williamson Garage Company, New Brunswick, N. J. General automobile garage business. Capital, $50,000. Incoryorators, W. M. Williamson, N. H. Smith, J. B. Buckalew.

Lord Manufacturing Company, New York. Manufacture and deal in electrical appliances, etc, Capital, $100,000. Incorporators, Fred W. Lord. Wm. R. Garton, Fred W. Erickson.

Vertical Bolt Rail Joint Company, New York. Manufacture and sell railway supplies, etc. Capital, $50,000. Incorporators, W. H. Delany, W. G. Clark, M. Kendall.

Sowers Manufacturing Company, Buffalo, N. Y. Manufacture and sell engines, boilers, etc. Capital, $100,000. Incorporators, Franklin D. L. Stowe, Geo. L. Grobe, E. O. Kerr.

Niagara Gasolene Motor Company, Buffalo, N. Y. Manufacture motors, engines, etc. Capital, $50,000. Incorporators, Chas. Jempsen, M. M. Hedden, Daniel M. Billington.

T. C. M. Manufacturing Company, Newark, N. J. Manufacture automobiles and parts. Capital, $100,000. Incorporators, A. Morris Thompson, Allan Coats, Wm. McKay.

Bowden-Snider Company, Mansfield, Ohio. Manufacture farm implements and machinery. Capital, $50,000. Incorporators, E. E. Bowden, S. F. Stutz, G. W. Snider, etc.

Electric Auto Horn Company, Zanesville, Ohio. Manufacture automobile horns. Capital, $10,000. Incorporators, Frank, Sam and Ben Weber, Sam Lind, Morris Weinberg.

Cass Motor Truck Company, Detroit, Mich. Manufacture commercial vehicles. Capital, $300,000. Incorporators, J. I. Turnbull, Geo. G. Epstean, Alex. M. Spater, F. W. Ferguson.

Auto Battery and Electrical Company, Buffalo, N. Y. Manufacture electrical devices and appliances for automobiles Capital, $20,000. Directors, T. P. Meinhard, C. B. Bleyler, Montford Ryan.

Niagara Metalware Manufacturing Company Buffalo, N. Y. Manufacture wood and metal specialties. Capital, $40,000. Incorporators, H. R. Schmeidendorf, W. R. Daniels, A. A. Schame, of Niagara Falls.

Enterprise Electric Construction Company, Cleveland, Ohio. Manufacture and sell electrical machinery. Capital, $25,000. Incorporators, W. K. Caldwell, Edgar M. Bell, I. H. Smith, etc.

James Kidney Motor Truck Company, Cincinnati, Ohio. Manufacture and sell automobiles and motor trucks. Capital, $10,000. Incorporators, Jas. P. Kidney, W. W. Ramsey, W. A. Stuart, etc.

International Telephone Company, Columbus, Ohio. Manufacture telephone equipment. Capital, $300,000. Incorporators, John C. Hewitt, of Athens, E. E. Larned, E. W. Brinker, K. Learned, etc.

James Fitt Machine Company, Rochester, N. Y Manufacture, sell, repair and deal in tools and machinery. Capital, $10,000. Incorporators, Jas. Fitt, 236 State street; C. P. Bryan, 183 Otis street, Rochester, and others.

Dayton Steel Construction Company, Dayton, Ohio. Manufacture ornamental and structural iron. Capital, $25,000. Incorporators, Perry M. Klepinger, Albert M. Klepinger, Charles E. Foreman, etc.

Twin City Manufacturing Company, North Tonawanda, N. Y. Manufacture and deal in wood tool handles, coat hangers, etc. Capital, $10,000. Incorporators, Fred F. Rievert, Tonawanda; Geo. J. Mechan, Buffalo, etc.

The Eagle Company, Newark, N. J. Manufacture cleaning machines, carpet sweepers, washing machines, etc. Capital, $1,500,000. Incorporators, J. F. Alvord, B. S. Keefer, F. P. Weston, Torrington, Conn.; J. R. Viles, New York; G. Badenoch, Newark.

BUSINESS ITEMS

Schuchardt & Schutte has opened a branch house at Prague, Bohemia, this in addition to the branches it now has in Austria Hungary at Vienna and Budapest.

C. Drucklieb, 178 Washington street, New York City, has disposed of his interest in the manufacture and sale of the injector sand blast apparatus to James N. Betton, who has had the practical management of this branch of his business for the past five years. The sand blast business will be carried on as heretofore, under the name of J. M. Betton, at 178 Washington street, New York City.

TRADE CATALOGS

Remington Tool and Machine Company, Boston, Mass. Circular illustrating and describing adjustable screw cutting die.

B. F. Sturtevant Company, Hyde Park, Mass. Bulletin No. 176, describing steam turbines. Illustrated, 16 pages, 6½x9 inches.

Northern Engineering Works, Detroit, Mich. Booklet No. 93, showing foundry machinery and equipment. 24 pages, 3½x5½ inches.

Automatic Buffing Machine Company, 22 Indiana street, Buffalo, N. Y. Catalog describing automatic buffing machines. Illustrated, 16 pages, 6x9 inches, paper.

Alliance Machine Company, Alliance, Ohio. Catalog of electric cranes, punches and shears, rolling mill machinery, steam hammers, etc. Illustrated, 88 pages, 8x11 inches, paper.

FORTHCOMING MEETINGS

Southern Supply and Machinery Dealers' Association and American Supply and Machinery Manufacturers' Association, joint convention, Jacksonville, Fla., April 5, 6 and 7, 1910, Hotel Seminole. F. D. Mitchell, secretary, 309 Broadway, New York City.

National Metal Trades Association, annual convention, Hotel Astor, New York City, April 13-14, 1910. Robert Wuest, Commissioner, New England building, Cleveland, Ohio.

International Railway General Foremen's Association, annual convention, May 3-7, Grand hotel, Cincinnati, Ohio. L. H. Bryan, secretary, Two Harbors, Minn.

National Machine Tool Builders' Association, spring convention, May 24-25, Rochester, N. Y. P. E. Montanus, Springfield, Ohio, secretary.

American Society of Mechanical Engineers, spring meetings, Atlantic City, N. J., May 31-June 3. Calvin W. Rice, secretary, 29 West Thirty-ninth street, New York City.

American Foundrymen's Association and American Brass Founders Association; joint convention, June 7-8-9, Detroit, Mich.; headquarters, Hotel Pontchartrain. Richard Moldenke, secretary, Watchung, N. J.

National Gas and Gasolene Engine Trades Association. Semi-annual convention. Cincinnati, Ohio, June 13-16, 1910; headquarters, Hotel Sinton. Albert Stritmatter, secretary, Cincinnati, Ohio.

Master Car Builders Association; annual meeting June 15-17, Atlantic City, N. J. J. W. Taylor, secretary, Old Colony building, Chicago, Ill.

American Railway Master Mechanics Association, June 20-22, Atlantic City, N. J. J. W. Taylor, secretary, Old Colony building, Chicago, Ill.

Joint meeting of American Society of Mechanical Engineers and Institution of Mechanical Engineers, Birmingham, England, July 26-29, 1910.

American Society of Mechanical Engineers; monthly meeting second Tuesday. Calvin W. Rice, secretary, 29 West Thirty-ninth street, New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's hotel. D. F. P. Clark, secretary, 309 Milk street, Boston, Mass.

Providence Association of Mechanical Engineers. Monthly meeting fourth Tuesday each month. E. C. Bliss, president, 91 Sabine street, Providence, R. I.

New England Foundrymen's Association; regular meeting second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania; monthly meeting third Tuesday. Elmer K. Hiles, secretary, Fulton building, Pittsburg, Penn.

Superintendents' and Foremen's Club of Cleveland; monthly meeting third Saturday. Phil. Frankel, secretary, 310 New England building, Cleveland, O.

Western Society of Engineers, Chicago, Ill. Regular meeting first Wednesday evening of each month, excepting July and August. Secretary, J. H. Warder, 1735 Monadnock block, Chicago, Ill.

WANT ADVERTISEMENTS

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendations or other papers of value should not be inclosed to unknown correspondents. Only bona-fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Caliper catalog free. E.G. Smith, Columbia, Pa.

Want to hire machine shop; may buy. Box 371, AMERICAN MACHINIST.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Special machinery accurately built. Screw machine or turret lathe work solicited. Robert J. Emory & Co., Newark, N. J.

Patented specialty wanted in line of heavy machinery. Schaeffer Machine Works, 35th & Gray's Ferry Road, Philadelphia, Pa.

Light and medium weight machinery and duplicate parts built to order; tools, jigs, etc. MacCordy Mfg. Co., Amsterdam, N. Y.

Patent novelties, dies and experimental work made by Louis L. Loeb, southwest corner Park Ave. & 131st St., New York. Correspondence solicited.

Draftsman, expert on pneumatic tools and compressed air machinery, who can furnish complete workshop drawings. Box 363, AMERICAN MACHINIST.

Wanted—Machine work for lathes, shapers, milling machines, screw machines, etc., and would be pleased to figure on your dies, jigs, models, sheet metal stampings and auto parts. The F. G. Marbach Co., Medina, Ohio.

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMERICAN MACHINIST.

Dies and press tools for sheet-metal formation designed and constructed in a modern shop, under personal supervision of the best die man in this country. For dies, presses and anything in sheet-metal formation write to Joseph V. Woodworth, Mgr. Harwood Mfg. Co., 42 South 8th Street, Brooklyn, N. Y.

Firm of engineers, with good central office, shortly opening showroom in Glasgow and having first-class connection throughout Scotland in the engineering trade, desire good agencies for machine tools of all kinds. Reply, stating terms, etc., to Box A.A.6, AMERICAN MACHINIST, 6 Bouverie St., London, E. C.

We wish to buy a second-hand slow-speed engine of about 3000 horsepower and about 75 revolutions; we prefer a vertical engine, but will consider a horizontal; also our preference would be to have one capable of carrying reasonable overload; we want the privilege of examination. Please write, stating price, to Pittsburgh Plate Glass Company, Advertising Department, Frick Building, Pittsburg, Penn.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CANADA

Wanted—First-class toolmakers, particularly on punches and dies, steady work; wages from 35c. to 45c. an hour. Apply Canadian General Electric Co., Ltd., Petersboro, Ont.

CONNECTICUT

Wanted—Diemakers. Apply to Robert N. Bassett Co., Derby, Conn.

Wanted—Experienced mechanical draftsmen for detail work, in a concern manufacturing general rolling mill and hydraulic machinery; state age, experience and salary expected. Box 366, AMERICAN MACHINIST.

Wanted—An A-1 Acme automatic screw machine man; one who can supervise, lay out and design his own tools, etc., and one who can get maximum production on high "quality work;" every condition the best; this opening is made by plant doubling its screw machine equipment, all new machines. Box 362, AMERICAN MACHINIST.

DELAWARE

Wanted—Draftsman experienced on tools, jigs and fixtures for interchangeable manufacture; preferably a man trained in the manufacture of fire arms; give age, experience and salary expected. Standard Arms Company, Wilmington, Del.

ILLINOIS

Concern in the Middle West manufacturing automobile and motor-cycle engines, require several experienced inspectors of material before and after being machined. Please state age, experience and wages expected. Box 354, AMERICAN MACHINIST.

INDIANA

Wanted—Machinists, we are continually increasing our force; we invite applications from lathe and floor hands, those who desire a steady position. Apply at Wood Turret Machine Co., Brazil, Ind.

MASSACHUSETTS

Toolmaker experienced in formed milling cutters; state age, experience and wages expected. Boston Gear Works, Boston, Mass.

Working foremen and machinists for day and night gangs; jobbing machine work and gear cutting; state age, wages expected and experience. Boston Gear Works, Boston, Mass.

We are increasing our force and invite applications from experienced iron and brass moulders, core makers, chippers, pattern makers, draftsmen, production men, machine tool operators (all kinds), brass finishers, polishers, layout men, bench hands, erectors, etc. Heavy and light engine and pump manufacture; works handy to Boston and best evening schools; no labor trouble, and applicants are notified as soon as positions are open; applicants should state age, height, weight and experience in detail. Address Employment Division, Blake & Knowles Steam Pump Works, East Cambridge, Mass.

MICHIGAN

Wanted—Bookkeeper, experienced in machine shop and cost accounting. Saranac Machine Co., St. Joseph, Mich.

Wanted—Toolmakers, die sinkers, lathe hands, machinists and automatic screw machine operators; A-1 men only. Buick Motor Co., Flint, Mich.

Wanted—Assistant superintendent for automobile factory; must be a hustler and able to show from past record that he can produce results, capable of handling men and have executive ability; age 28 to 35; in answering give references, experience and salary expected. Box 287, AMERICAN MACHINIST.

Wanted—By a concern manufacturing Corliss and slide-valve engines and other machinery, a thoroughly competent machinist, familiar with the efficient operation of large and small machine tools and the design of jigs, special tools, etc., to act as assistant to the foreman in machine shop employing 75 men, for the purpose of instructing employees as to best methods of doing work and to devise tools, jigs, etc., for attaining the most economical production. Write fully, giving experience and salary expected. "Expert," AMERICAN MACHINIST.

NEW JERSEY

Wanted—Draftsmen familiar with heavy turret lathe work; give references and salary expected. Box 216, AMERICAN MACHINIST.

Wanted—First-class designer, draftsman and detailer on rotary printing machinery; A-1 man only; steady positions. Hall Printing Press Co., Dunellen, N. J.

Wanted—Machinists; steady work for good milling, boring, lathe and floor hands; also tool and die makers; call in person if possible; cheap rents and pleasant surroundings. Ferracute Machine Company, Bridgeton, N. J. (40 miles south of Philadelphia).

NEW YORK

Wanted—A few draftsmen familiar with design of tools, electrical apparatus and switchboard layouts. Apply General Electric Company, Engineer in Charge, Drafting Dept., Schenectady, N. Y.

Wanted—Toolmakers on model and experimental special automatic machine work; good pay and steady work to competent men. Apply to S. S. White Dental Mfg. Co., Princes Bay, S. I., New York.

Wanted—First-class case hardener accustomed to heat treatment of automobile parts with Brown & Sharpe furnaces; state experience, reference, age and salary expected. Box 337, AMERICAN MACHINIST.

Wanted—Machinists and toolmakers, experienced on tools for valve work preferred; location, Central New York; in reply state age, experience, married or single and wages expected. Box 367, AMERICAN MACHINIST.

Wanted—Screw machine foreman, must be aggressive and used to quick set-ups; job consists of Brown & Sharpe and Gridley automatics and 15 to 18 hand machines; position steady, salary liberal. Box 342, AM. MACH.

Wanted—A chief draftsman by a large, well known automobile manufacturing concern in New York State; must be capable of handling large force of draftsmen; state age, education, experience and salary expected. Box 364, AMERICAN MACHINIST.

Wanted—Assistant foreman, thoroughly experienced in gears, to take charge of gear department, in large works in New York City suburb, cutting large bronze spiral and worm gears; applicants must state experience, age and salary expected. Box 368, AMER. MACH.

Wanted—Superintendent for new vacuum cleaner factory; must be thoroughly familiar with modern methods of mass production; splendid opening for able man; must show good record and be at present employed. General Specialty Co., Niagara and Massachusetts Sts., Buffalo, N. Y.

Wanted—Superintendent or works manager for long established printing press factory; experience in our line preferred; must be a hustler and able to show from past record that he can produce results, capable of managing men and estimating closely, and have executive ability. Address, giving references, experience, age and salary. Box 374, AM. M.

Wanted—We are constantly increasing our force and invite applications from the following: Machinists, lathe hands, screw machine hands, grinder hands, milling machine hands, motor assemblers, toolmakers, sheet metal die men; we run a nine-hour shop, have desirable surroundings, and offer steady position to desirable characters. Address Superintendent, Maxwell-Briscoe Motor Co., Tarrytown, N. Y.

OHIO

Wanted—Draftsman, familiar with detail crane design; state wages desired. The Toledo-Massillon Bridge Co., Toledo, O.

Wanted—Floor, planer, lathe and milling machine hands; permanent position, good pay; no labor troubles. Box 337, AMER. MACH.

Wanted—By Cleveland firm, several capable draftsmen, expert in motor-car work; only experienced men need apply; situation permanent to the right men. Address, stating experience, age, qualifications, etc., to Box 341, AMERICAN MACHINIST.

Wanted—First-class machinists, toolmakers die sinkers, lathe, planer, drill press, screw machine, boring and milling machine operators, wood patternmakers, brass molders, polishers, buffers, finishers, spinners, millwrights, hammermen and blacksmiths who are seeking positions or desirous of improving on those which they have, to register their names and addresses with the free Employment Department of the National Metal Trades Association. Address Commissioner's Office, 605 New England Bldg., Cleveland, O.

PENNSYLVANIA

Wanted—Experienced draftsman, capable of designing jigs and fixtures for machine tool work. Address Colburn Machine Tool Co., Franklin, Penn.

Wanted—Mechanical superintendent or general foreman, familiar with engine and boiler practice; state qualifications and expectations. Address General Manager, Box 361, AMERICAN MACHINIST.

Wanted—Draftsmen, detailers and tracers, by large steel company in the East; applicants must state age, experience, salary expected, and how soon they can report for work. Box 353, AMERICAN MACHINIST.

Mechanical draftsman; wanted at once one first-class draftsman familiar with the design of steam and centrifugal pumps; give age, experience, education, salary expected, and how soon can start. Box 338, AMER. MACH.

Foreman's assistant wanted in Philadelphia; must be experienced with tools for stamping, drawing and forming sheet steel; duties are setting dies in presses and handling a branch of press room; opportunity for a hustler, and one with ability for handling men to economically make articles from heavy sheet metal; one with bulldog stick-to-itiveness preferred; give age, experience and salary expected; answers kept in confidence. Box 358, AMERICAN MACHINIST.

TENNESSEE

Wanted—First-class draftsman; one familiar with gas engine and gasolene motor car engine designs; only thoroughly experienced, practical man need apply; state wages desired. P. O. Box 358, Chattanooga, Tenn.

WISCONSIN

Draftsman—Wanted, a draftsman familiar with tool and jig work. Address Fairbanks-Morse Mfg. Co., Beloit, Wis.

Situations Wanted

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CALIFORNIA

Mechanical engineer, technical graduate, expert designer, with unusual inventive ability, experienced in gas engines, pumps and large installations, thoroughly experienced in handling machine shop, desires position as designer, engineer, or superintendent of construction with first-class company; now engaged; state salary. Box 355, AMER. MACH.

CONNECTICUT

Mechanical engineer and draftsman, technical graduate, 5 years' experience in mill and power plant work, desires position. Box 365, AMERICAN MACHINIST.

Position as designer and draftsman; experienced on automatic machinery, jigs, fixtures and tools for interchangeable work; can superintend construction of same, and furnish references. Address Waterbury, Care AM. M.

ILLINOIS

A successful superintendent of the Otis Elevator Company is seeking change of position. Address Box 230, AMER. MACHINIST.

Position as superintendent; have a thorough knowledge of best machine shop and foundry practice; can get maximum production from men and equipment; accustomed to large works; good reasons for changing. Box 373, AMERICAN MACHINIST.

INDIANA

Foreman toolmaker, jig and fixture designer, experienced in outlining methods and operations in shop, wants to advance in position; go anywhere. Box 340, AMER. MACHINIST.

MASSACHUSETTS

Mechanical draftsman desires change; at present with electrical concern; age 30; go anywhere. Box 348, AMERICAN MACHINIST.

Foreman, uptodate in modern shop methods, wide experience on price and rate setting, at present employed, desires change; age 39. Box 370, AMERICAN MACHINIST.

NEW JERSEY

First-class instrument maker on experimental work or small special machines, wishes position. Box 357, AMERICAN MACHINIST.

NEW YORK

Mechanical draftsman wants night or job work; New York city vicinity. Box 345, AMERICAN MACHINIST.

As superintendent or general foreman, by expert in light manufacturing, tool and special machine designing. Box 372, AM. MACH.

Mechanical draftsman, designer, wants position, engines, pumps and general machinery; best references. Box 344, AMER. MACHINIST.

General foreman or superintendent with executive ability, desires a position; experienced on engines and automatic machinery of all kinds; excellent references. Box 356, AMERICAN MACHINIST.

Experienced foreman, middle aged, modern ideas, now employed; engineering work, dynamos and steam pumps; A-1 hustler; can handle large force with ability. Box 352, AMERICAN MACHINIST.

OHIO

Designer and draftsman desires to change; go anywhere. Box 347, AMER. MACHINIST.

Tool room foreman, who is a first-class toolmaker, thoroughly understands and can design and build draw, compound and subpress dies, jig and gage work; no objections to going abroad; best of references. Box 359, AMERICAN MACHINIST.

RHODE ISLAND

A good executive and designer of modern tools for manufacturing, now bringing out a heavy sewing machine, desires change; parties with promises of superintendent with contracts drawn up so as to avoid living up to it, will require some other bait, as legitimate openings will be considered only. Address Z. Lambert, 835 Atwells Ave., Providence, R. I.

FOR SALE

For Sale—200-horsepower Harris-Corliss engine in perfect condition; the reason for selling mill business discontinued. The Elm City Lumber Co., New Haven, Conn.

For Sale—One Nash gas engine, 20 horsepower, two cylinder, for electric lighting, pumping or power; one Beaman & Smith horizontal boring mill; table 25 inches wide, 36 inches long; will bore 12 inches diameter, 24 inches long, and face 20 inches diameter; one 300 light J. B. Colt Co. acetylene gas apparatus. The above machines are in excellent condition, having been very little used. For further particulars and prices apply to Rider-Ericsson Engine Co., 35 Warren St., New York.